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Heeman et al.

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(54) **SLEEVING DEVICE, METHOD AND MANDREL FOR ARRANGING SLEEVES AROUND PRODUCTS**

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B65C 9/00 (2006.01)
B65C 3/06 (2006.01)

(52) **U.S. Cl.**
CPC ***B65B 11/00*** (2013.01); ***B65C 3/065*** (2013.01); ***B65C 9/0065*** (2013.01)

(58) **Field of Classification Search**
CPC B65B 9/14; B65B 41/00; B65B 53/00
USPC 53/397, 399, 441, 442, 459, 556, 557, 53/567, 582, 585, 291; 156/86, 217, 218, 156/458, 556, 566
See application file for complete search history.

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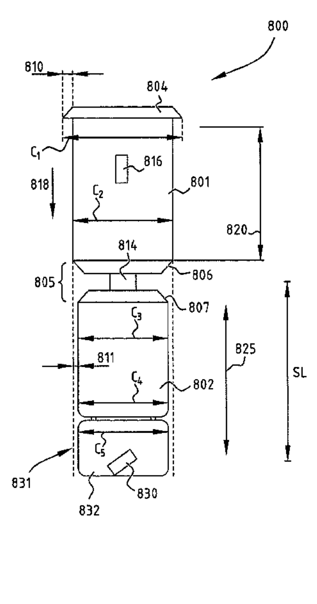
(57) **ABSTRACT**

The invention relates to a method, a sleeving device and a mandrel for arranging sleeves around products such as containers. Foil is opened on the mandrel and fed over the outer surface of the mandrel. The foil is cut at a first position to form individual sleeves of predetermined length. Sleeves are discharged in axial direction from the mandrel over the product. The sleeves are discharged by engaging the sleeves at a second position. The circumference of the outer surface of the mandrel near the second position is smaller than the circumference of the outer surface of the mandrel upstream from the first position.

25 Claims, 13 Drawing Sheets



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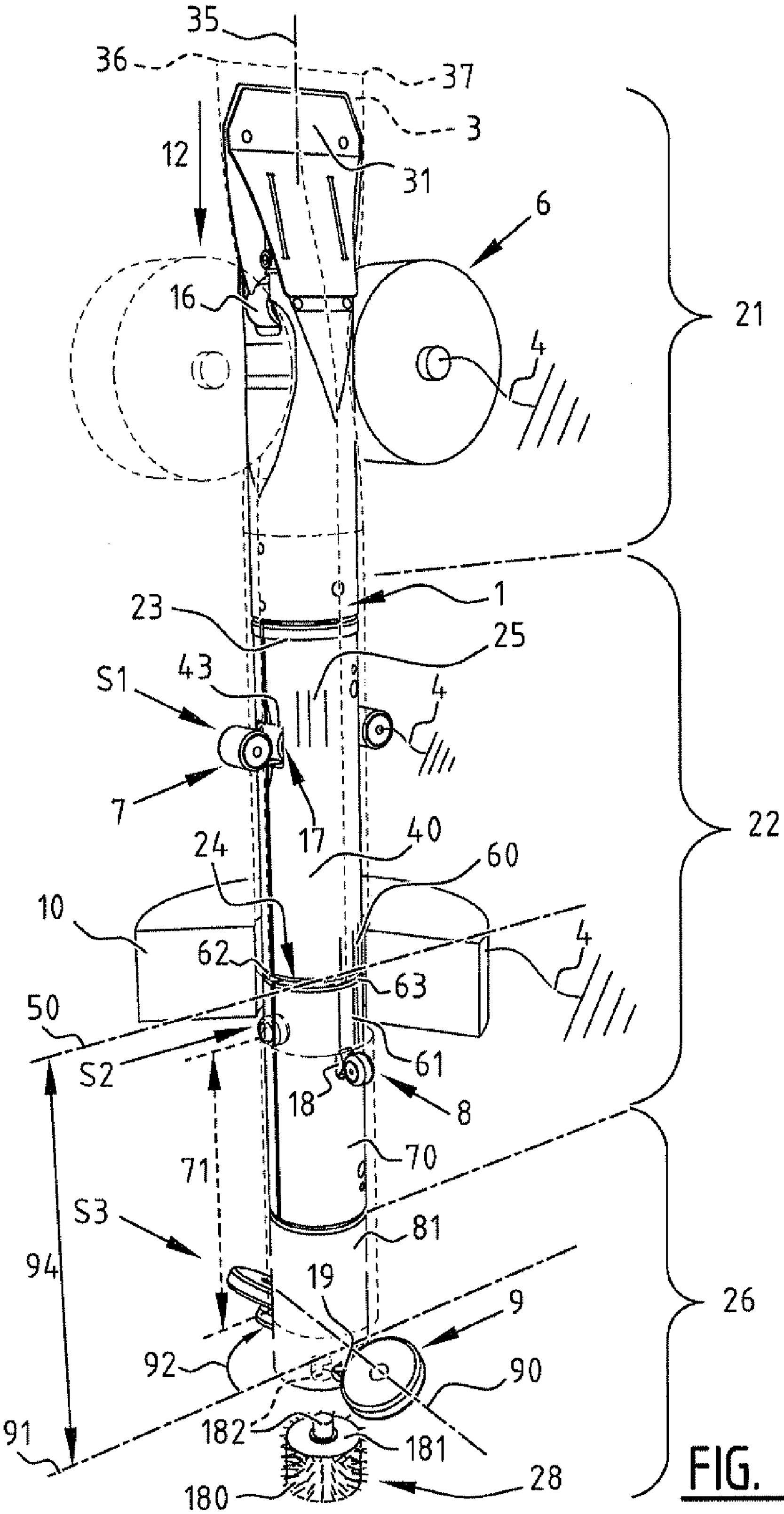
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FIG. 1

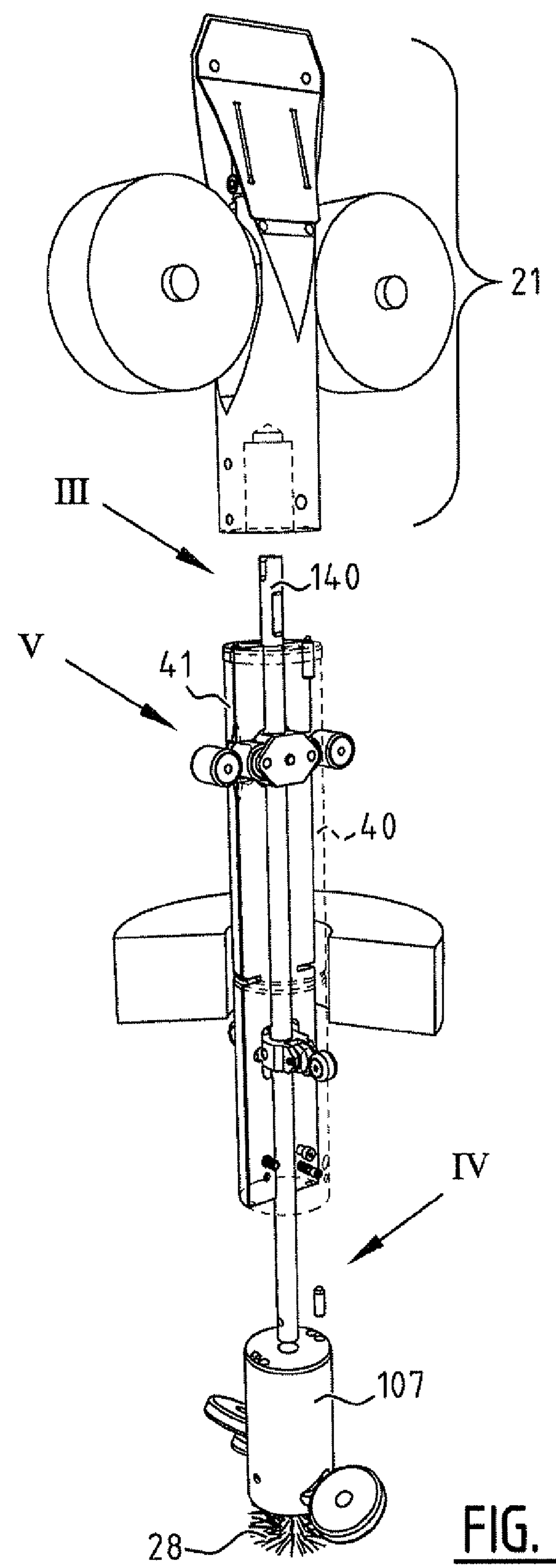

FIG. 2

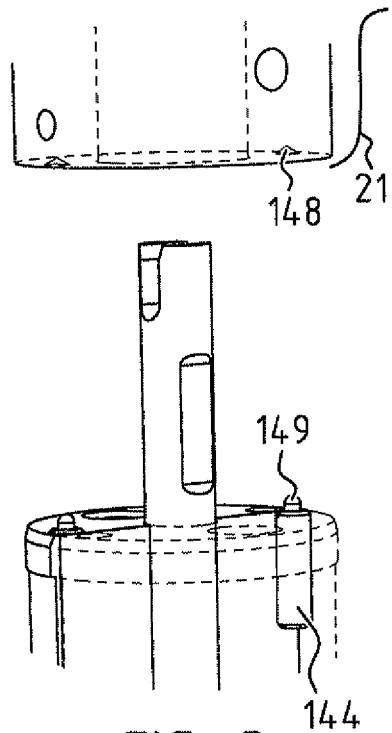

FIG. 3

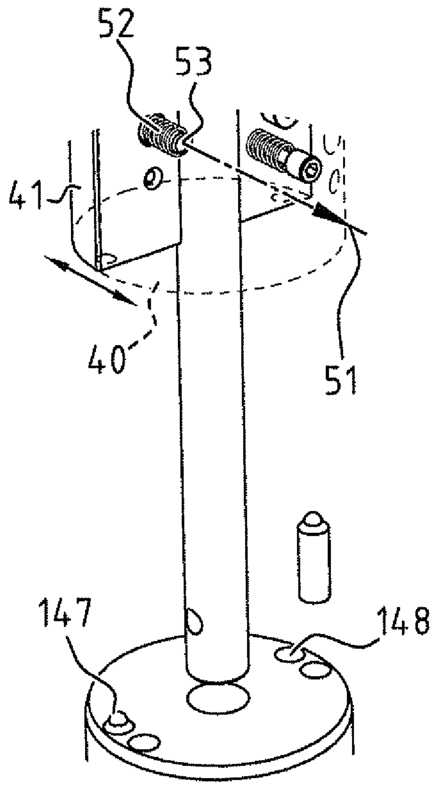

FIG. 4

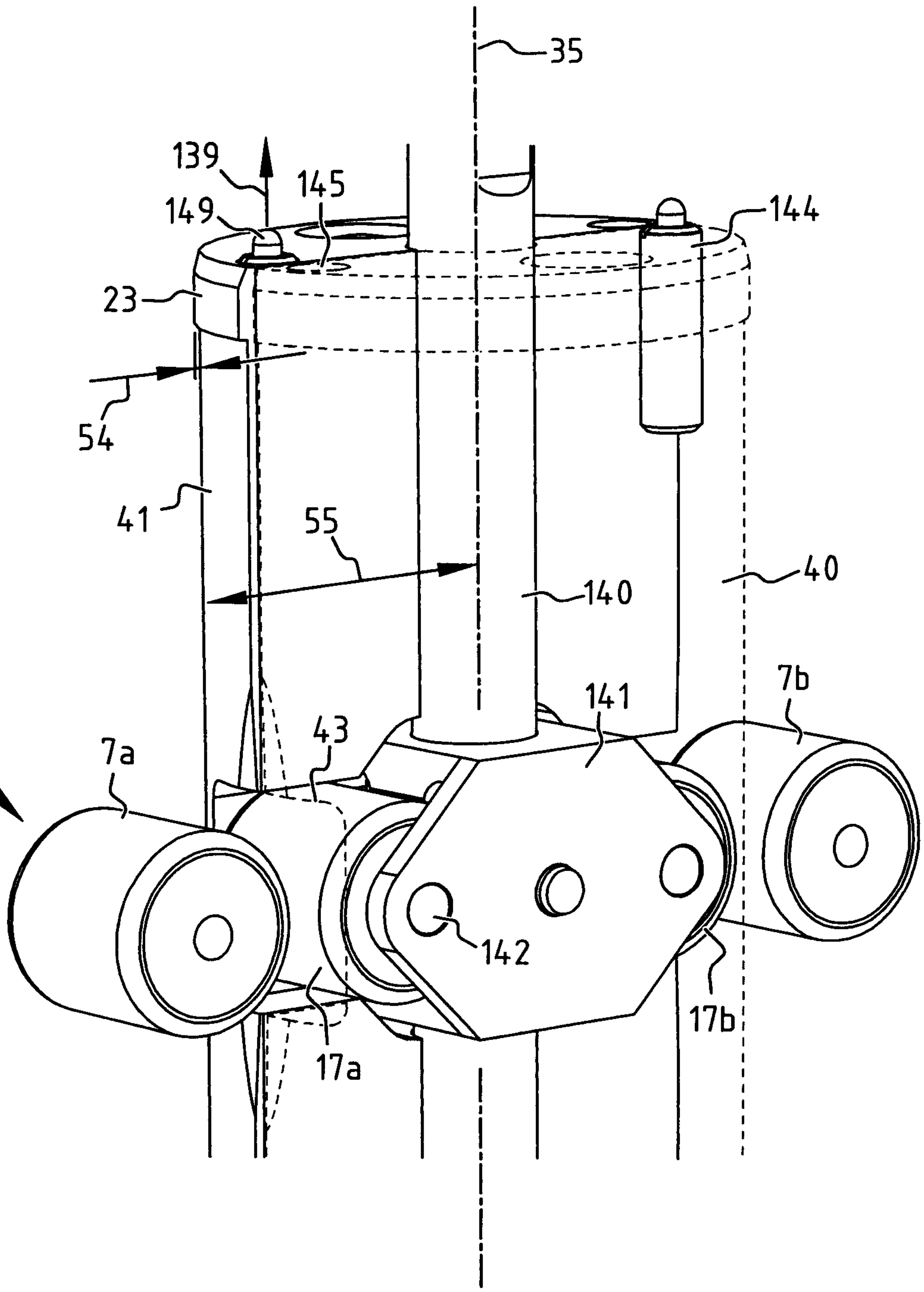

FIG. 5

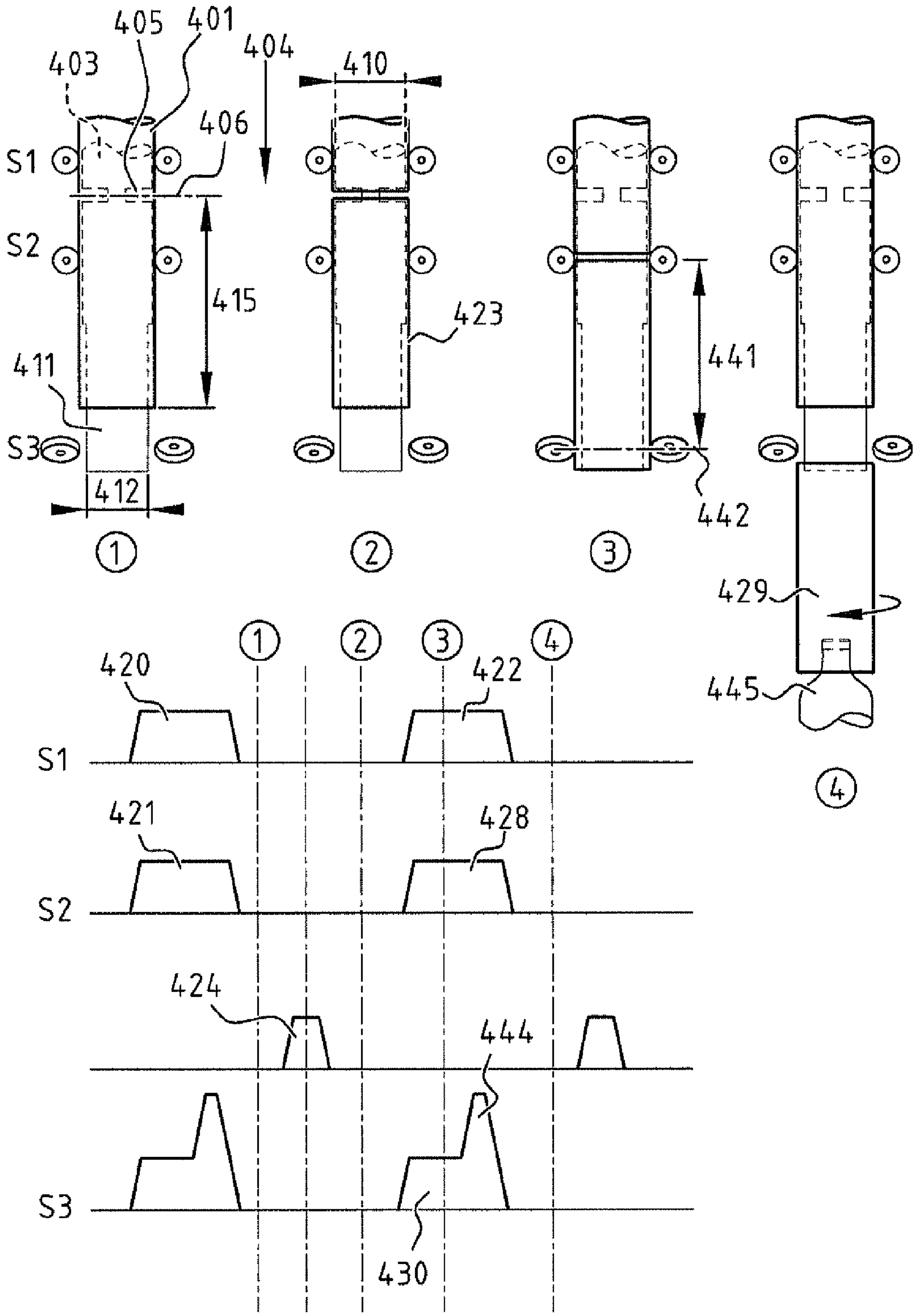
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FIG. 6A

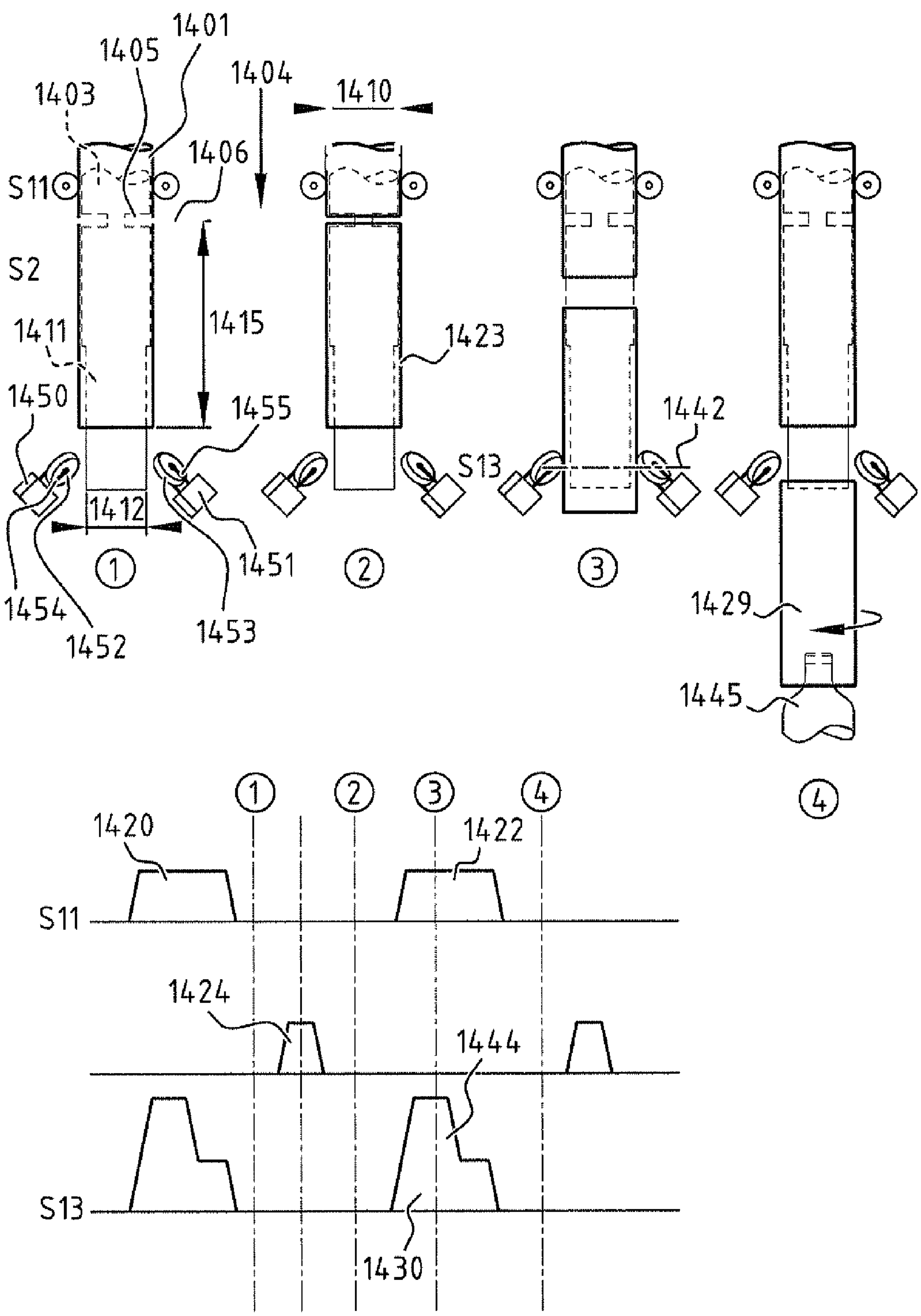
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FIG. 6B

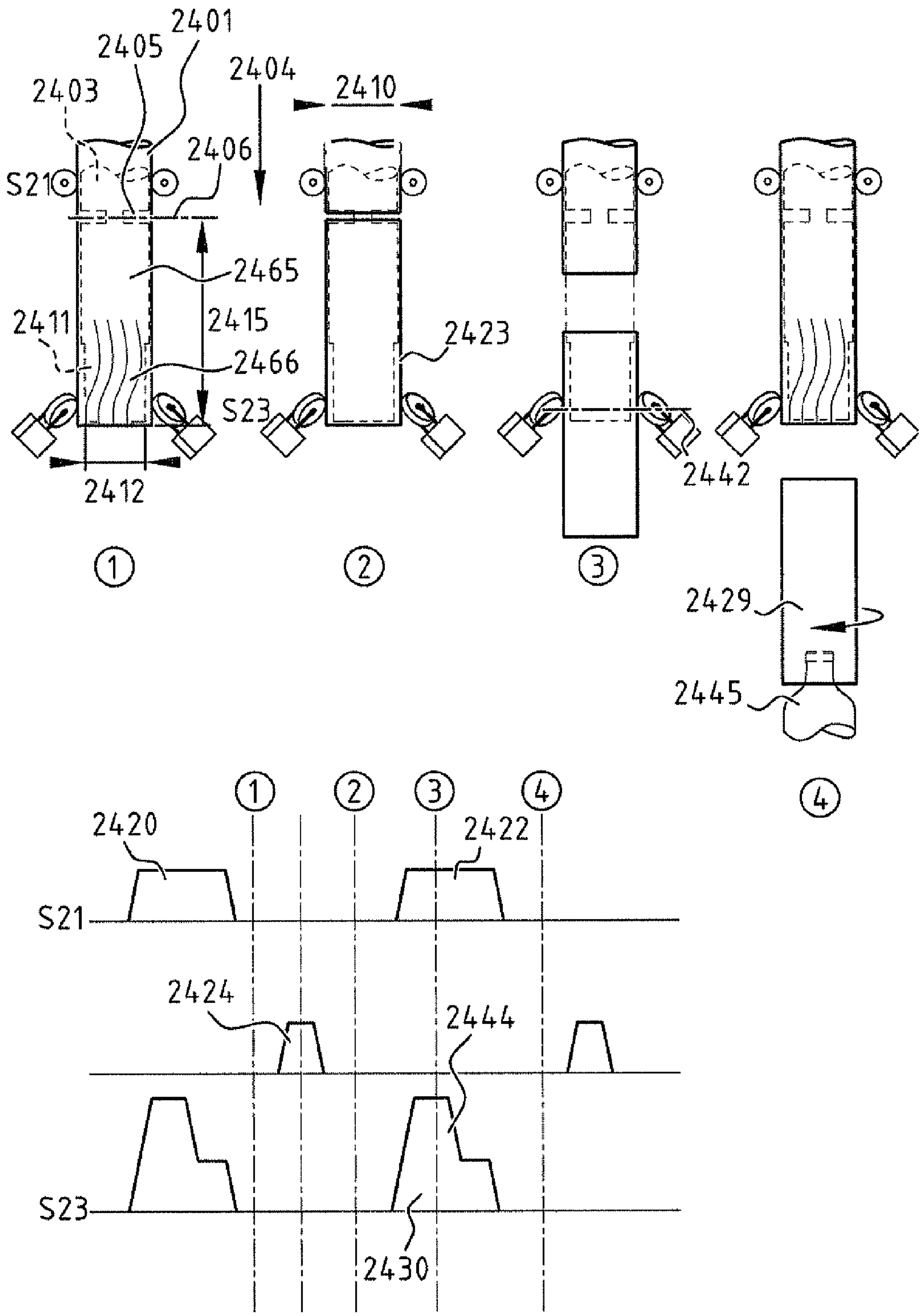

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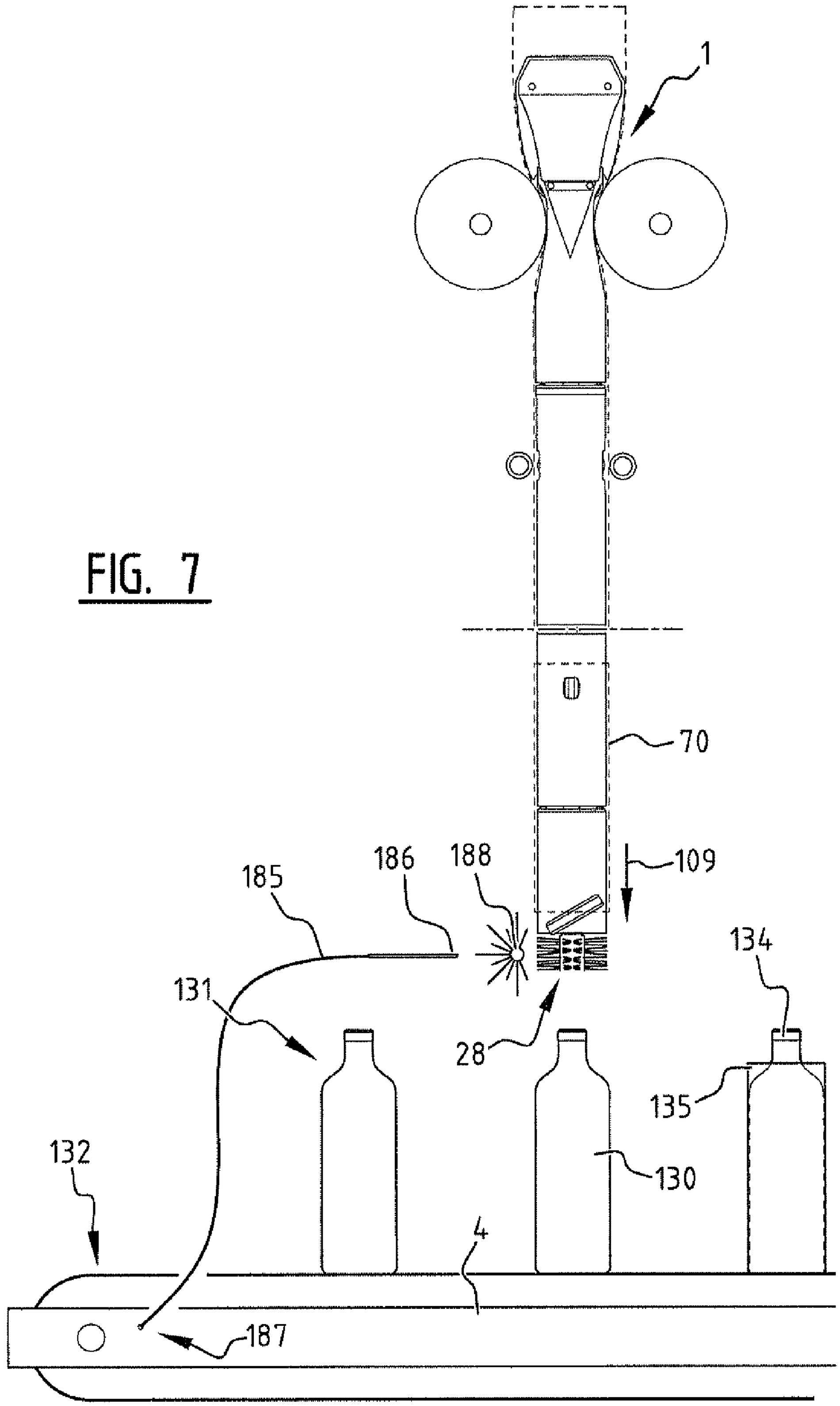
FIG. 6C

FIG. 7



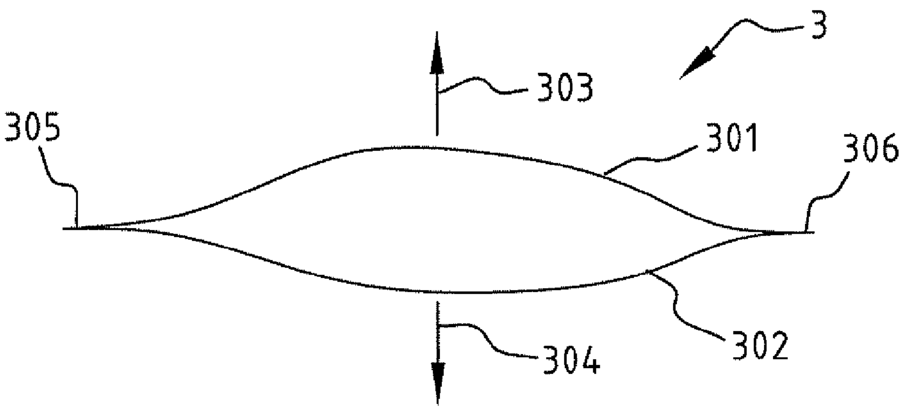


FIG. 8A

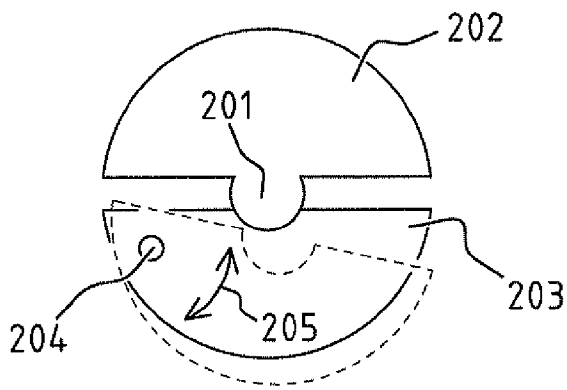


FIG. 8B

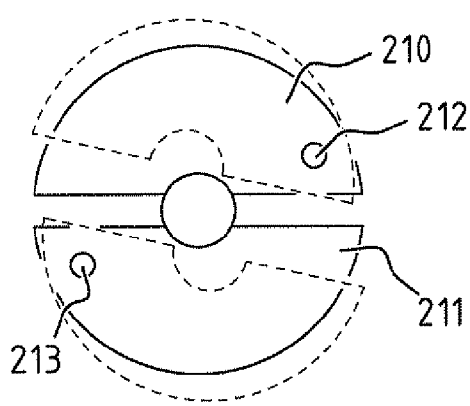


FIG. 8C

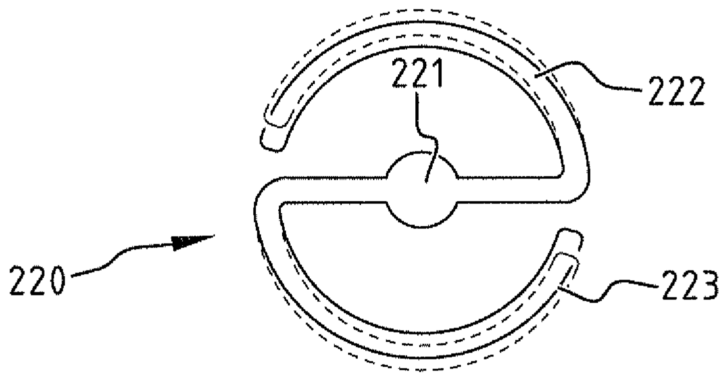


FIG. 8D

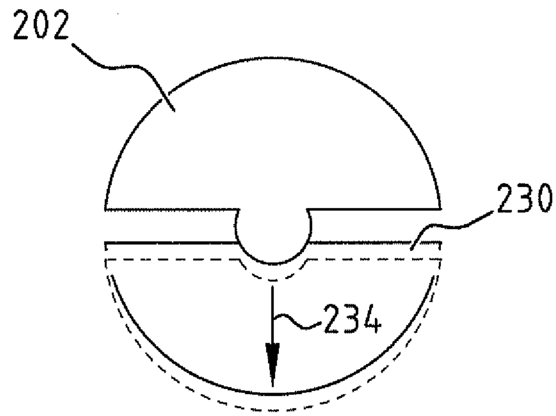


FIG. 8E

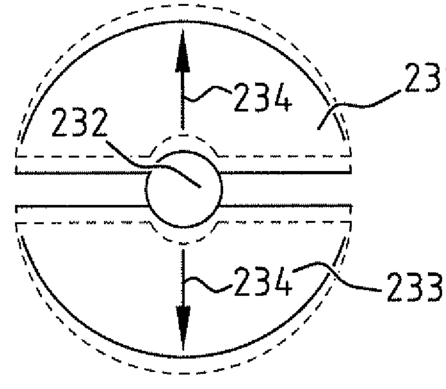


FIG. 8F

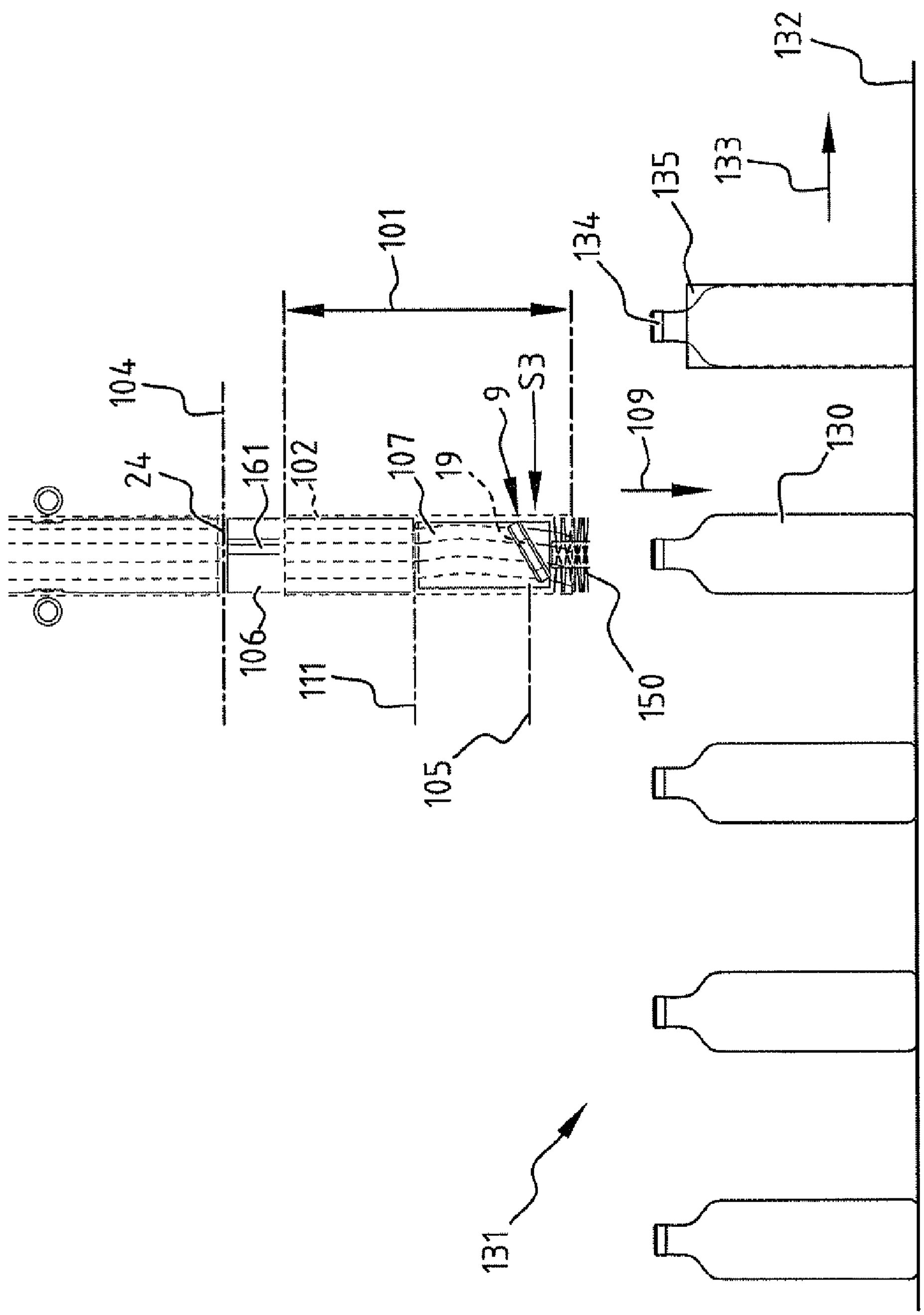


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FIG. 9

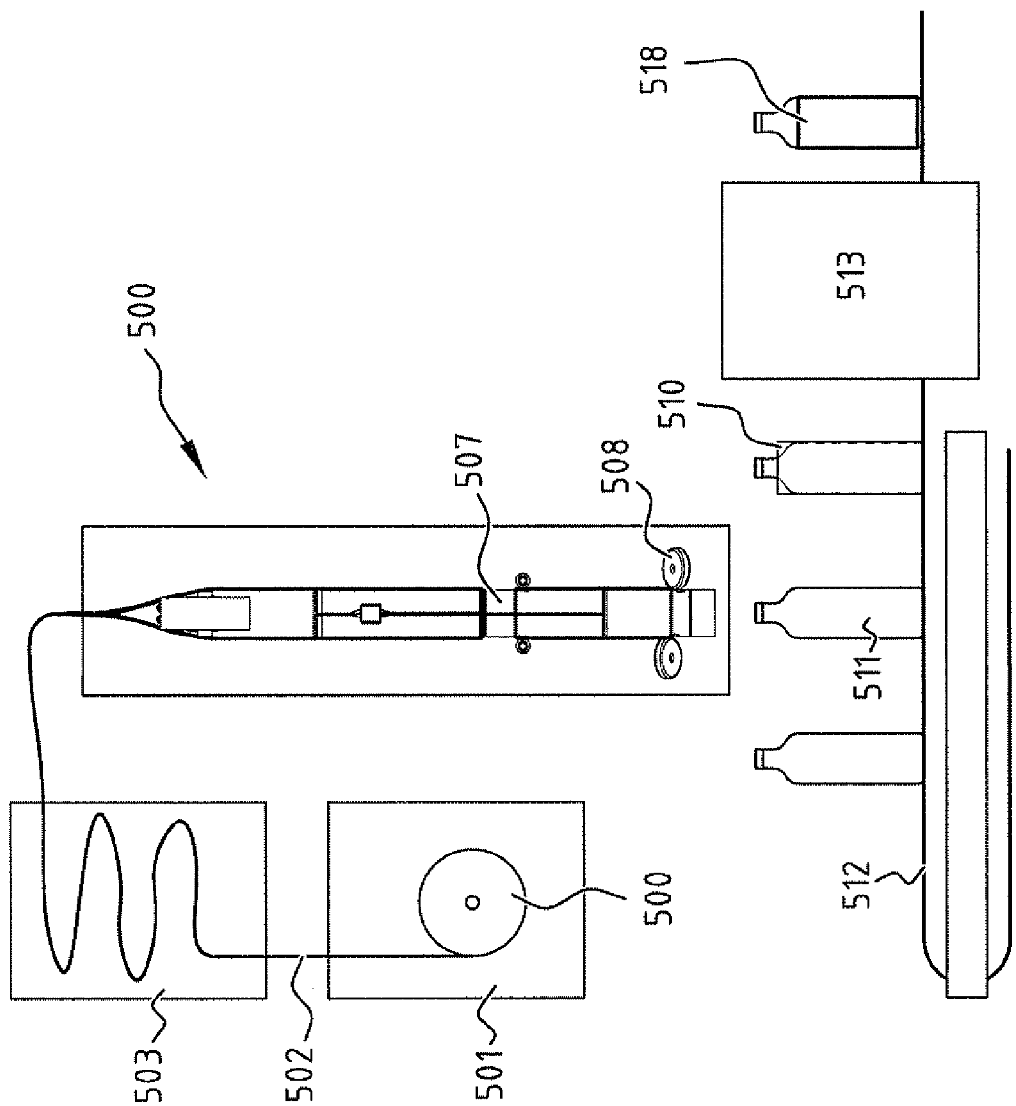

FIG. 10

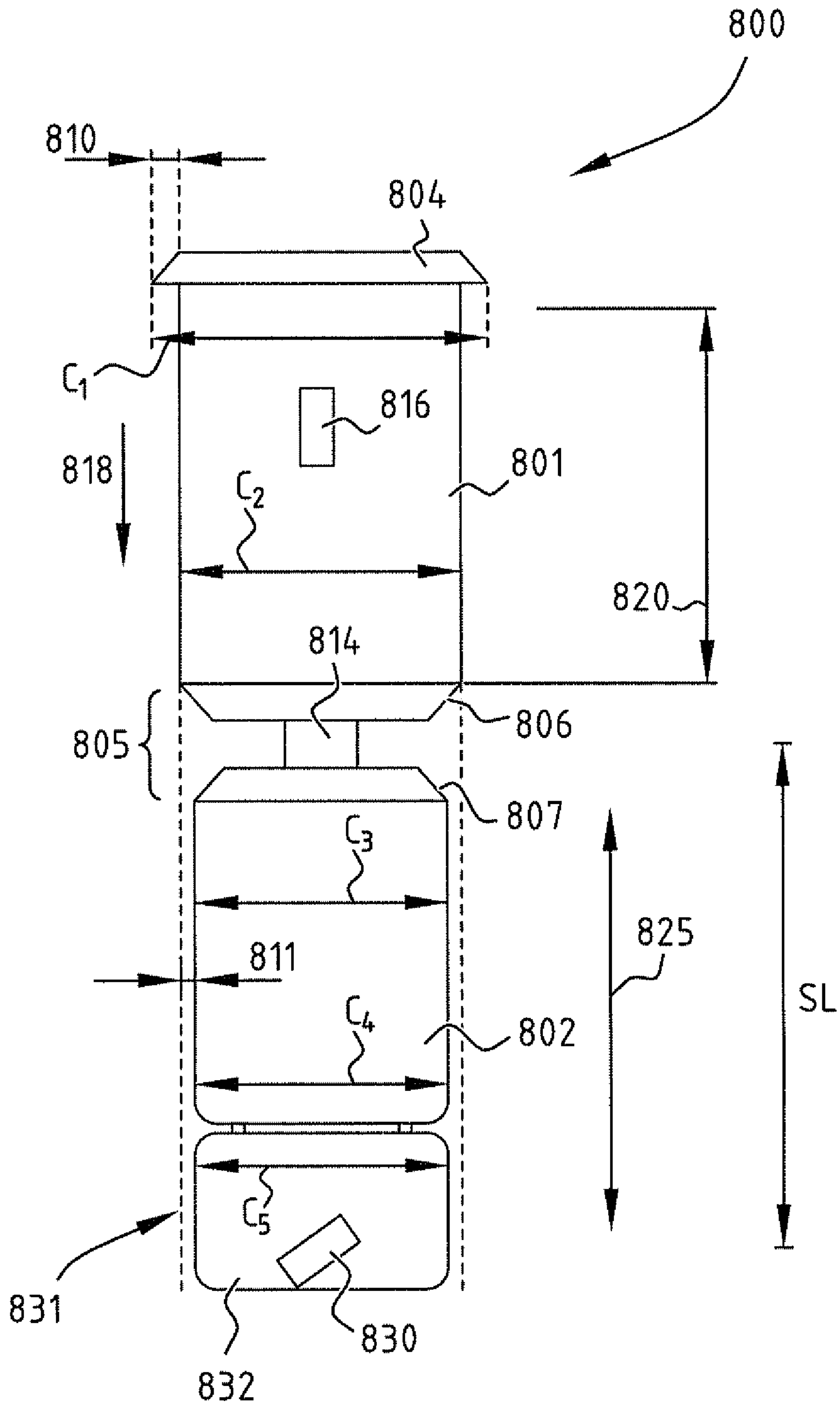
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FIG. 11

SLEEVING DEVICE, METHOD AND MANDREL FOR ARRANGING SLEEVES AROUND PRODUCTS

The invention relates to a sleeving device for arranging sleeves around products such as containers, as well as a mandrel and a method therefor.

From WO 2008/088210-A1 from the same applicant a sleeving device and method is known. The complete disclosure is incorporated by reference. The sleeving device allows arranging the sleeve around the product and rotates the sleeve as the sleeve is shot from the mandrel around the product aligned with the axial direction of the mandrel. The sleeve is rotating while the sleeve is still around the mandrel.

The known device/method comprises the sleeve discharge unit providing the rotational movement engaging the foil before the foil is cut into sleeves of predetermined length (or 'cut length').

It is a goal of an aspect of the invention to improve the cutting quality of the sleeving device, reducing the formation of pigtails.

This is achieved according to an aspect of the invention in an embodiment of the sleeving device comprising a frame, a feed unit for feeding foil, a mandrel, a cutting device arranged to cut the foil fed around the mandrel at a first position, and a sleeve discharge unit for discharging sleeves from the mandrel over the product. Foil, a continuous flat strip of sleeve-like foil, is provided from a stock, e.g. a roll. It is fed to the mandrel using a feeding unit. The mandrel is suspended in the sleeving device. By feeding the foil over the mandrel having a tubular or cylindrical outer surface, the foil is opened. The mandrel in combination with a cutting device allows cutting the foil in individual sleeves of predetermined length. By feeding a predetermined sleeve length of foil beyond a first position, the foil can be cut to the predetermined sleeve length. Cutting the foil will result in an individual sleeve of that predetermined sleeve length, downstream from the cutting device. This cut sleeve is still held around an outer surface of the mandrel. Further downstream, still on the mandrel, a sleeve discharge unit discharges the sleeve from the mandrel, e.g. using a sleeve shooter. The sleeve is arranged around a container aligned with the axial direction of the mandrel.

In an embodiment of the invention the sleeve discharge unit is arranged for imparting a rotational movement to the sleeve around an axial axis, e.g. by comprising a rotational sleeve discharge unit. In order to discharge and to rotate, the rotational sleeve discharge unit engages the foil or individual sleeve at a second position.

According to an aspect of the invention the outer surface of the mandrel upstream from the blade clearance is arranged to provide radial positioning of the foil and has a first circumference. A second circumference of the outer surface of the mandrel downstream from the blade clearance is smaller than the first circumference. In an embodiment near the first circumference of the outer surface of the mandrel is close to the inner circumference of the sleeve/foil fed around the mandrel.

The first circumference of the outer surface of the mandrel is arranged such that the foil is provided with or maintains a tubular tension in the radial direction. This tension reduces the formation of pigtails during cutting. Further downstream the cut sleeve is fed over an outer surface having a reduced circumference, reducing friction.

In an embodiment the second circumference is the circumference of the outer surface at the second position. The rotational movement of the cut sleeve is improved during discharging as, due to reduced circumference, the friction between the sleeve and the outer surface is reduced. In an embodiment rollers extend outwardly from the mandrel. These extending rollers are not taken into account in measuring the circumference of the outer surface. In another embodiment the rollers are positioned internal in the mandrel.

In other embodiments the second circumference is the circumference of the mandrel downstream from the blade clearance at 20%, preferably at 50% and more preferably at 80% of the sleeve length of the sleeve to be cut.

In an embodiment the circumference of the mandrel can increase toward a downstream part. Although not preferred, a local necking of the outer surface of the mandrel in between 20% and 80% of the sleeve length downstream from the blade clearance, can already achieve the benefits of the invention.

Further downstream towards the second position the circumference can be reduced, allowing e.g. twisting of the foil. By providing extra tolerance as a result of the reduced circumference, small deviancies can be countered using foil properties. In the end the cutting result, less pigtails, is improved.

The circumference of the mandrel according to this application is the circumference of the outer surface of the mandrel. If a sleeve is to be fed around the mandrel, the sleeve would need a minimum circumference at least allowing to be fed around the mandrel.

An example of an embodiment according to the above feature comprises a rotational sleeve discharge unit embodied by a roller. In a further embodiment the discharge unit is mounted on the frame via an actuator. The foil/sleeve is fed over the mandrel into the position allowing cutting of the foil in the sleeve of predetermined length. When that position is reached, the actuator moves and presses the roller onto the foil/sleeve. The engagement can be at a position closer to the blade clearance than the predetermined sleeve length. The sleeve is cut and discharging the cut sleeve comprises imparting the rotational movement onto the sleeve.

In an embodiment the first circumference and the second circumference are circumferences of parts of the outer surface of the mandrel extending in the axial direction having a generally constant circumference. The mandrel can have tubular parts extending over a distance in the axial direction having a constant circumference. The outer surface part downstream from the blade clearance has a smaller circumference.

In an embodiment the mandrel comprises a diaphragm upstream from the blade clearance, wherein the first circumference is between 98%-99.9% of a circumference of the diaphragm. Preferably the first circumference will be between 99% and 99.5% of the circumference of the diaphragm. Such an outer surface having a circumference close to the inner circumference of the foil will provide radial positioning of the foil and tension in the foil reducing the formation pigtails during cutting. In embodiments the circumference difference diaphragm/first circumference is between 0.25 and 1.6 mm.

In an embodiment the second circumference is between 90%-99.5% of the circumference of the diaphragm. Preferably the second circumference is 95%-99% of the diaphragm circumference. The second circumference will allow more space in order to reduce friction as a result of spinning the sleeve during ejection. In embodiments the circumference difference diaphragm/second circumference is between 0.6 mm and 6.4 mm, preferably between 1 mm and 5 mm.

In an embodiment the sleeving device comprises a supply unit for supplying foil, the supply unit comprising at least a transport roller positioned downstream from the diaphragm and upstream from the blade clearance. This transport roller will draw the foil over the diaphragm.

In an embodiment the mandrel comprises a necking-in. Upstream from the necking-in the mandrel has a cross section. Downstream from the necking-in the mandrel has a similar cross section but smaller, having a smaller circumference.

In an embodiment the second circumference is more than 0.5%, in some embodiments more than 1%, smaller than the first circumference. This will allow sufficient space to allow the foil to free absorb deficiencies without disrupting the cutting process. In an embodiment a radius at the second position is at least 0.25 mm, preferably at least 0.4 mm smaller.

In an embodiment the mandrel comprises a foil wrinkling space. This foil wrinkling space, including the second position, allows twisting of the foil e.g. as a result of the engaging of the foil by the sleeve discharge unit, specifically the rotational sleeve discharge unit. The foil wrinkling space extends from the second position upstream. The twisting is allowed of a limited distance upstream from the second position. The foil wrinkling space starts downstream from the necking-in.

If the mandrel would have a first radius R_1 upstream from the blade clearance and the mandrel would continue to extend between the first and second position ($d_{1\rightarrow 2}$) having the same radius, the mandrel would have a volume of $V_{R1}=\mathrm{pi}(R_1)^2 * d_{1\rightarrow 2}$. The removed volume $V_{removed}$ (which forms the foil wrinkling space) is defined as the continuous volume, if radius is R**1** defined as V_{R1}, minus the actual volume of the mandrel (V_{actual}). $V_{removed}$ according to an embodiment is at least 1.4 cm^3, preferably at least 2 cm^3, and more preferably at least 2.5 cm^3.

In an embodiment circumferences of parts of the outer surface of the mandrel directly upstream and downstream of the blade clearance are generally equal. This generally symmetrical embodiment will reduce the formation of pigtails during cutting as force working on the foil are symmetrical. However a symmetrical arrangement is not necessary.

In a further embodiment the blade clearance comprises a chamfer on the downstream side or both sides of the blade clearance. The downstream chamfer allows guiding the foil onto the outer surface.

Preferably the circumference of the outer surface remains substantially constant over a part of the downstream end of the mandrel, downstream from the first position. In an embodiment a substantially constant circumference is maintained over more than 20%, preferably more than 30% of the distance between the first and second position. By maintaining the 'large' circumference the sleeve is supported closely in its tubular form close to the cutting device, preventing pigtails. Deficiencies are caught in the more downstream part, near the second position.

Preferably two mandrel parts extending in the axial direction form the downstream part of the mandrel from the first position, the two parts having different circumferences. The two parts each have a substantially contant circumference. The sleeve shot (downstream) part has a reduced circumference.

In an embodiment the distance between first and second position is substantially equal to the desired length. The discharge unit will engage the foil prior to cutting. A rotational discharge unit can cause twisting. The reduced circumference limits the extent of the twisting of the foil. The larger circumference of the mandrel upstream and near the first position prevents the twisting to reach the cutting device/first position.

In an embodiment the rotational sleeve discharge unit engages the sleeve only after performing the cutting. This prevents twisting prior to cutting. An example of an embodiment according to this embodiment comprises a rotational sleeve discharge unit embodied by a water jet or compressed air nozzle. The foil/sleeve is fed over the mandrel into the position allowing to cut the foil in the sleeve of predetermined length. The sleeve is cut and discharge comprises imparting the rotational movement onto the sleeve by the water jet/compressed air nozzle, positioned downstream from the cutting device.

Several embodiments of feeding units and/or sleeve discharge units fall within the scope of protection, including, but not limited to a nozzle providing pressured air directed at the sleeve, either towards an outside surface of the sleeve or towards an inside surface, to a water jet directed at the sleeve, to rollers and/or to brushes.

In order to impart a rotational movement onto the sleeve the direction of the nozzle/jet/roller/brush can be at an angle with respect to the axial direction of the mandrel. In preferred embodiments the sleeve discharge unit comprises only one or more rotational sleeve discharge units.

The sleeve discharge unit and/or feeding units can be mounted on the frame, connected to the mandrel or both. In an embodiment foil/sleeves are transported between the feeding units/discharges units mounted on the frame and mandrel. Rollers positioned on the mandrel can extend 1-4 mm, preferably 2-3 mm from the mandrel outer surface. In an embodiment the radial extension of the rollers from the mandrel near the second position is similar to the extension of roller on the mandrel near the first position. In another embodiment the rollers near the second position extend more.

In an embodiment the rotational sleeve discharge unit comprises a drive, a driven shaft and a roller connected to the shaft. The roller engages on the outer surface of the foil. The foil is sandwiched between exterior rollers and rollers extending from the outer surface of the mandrel. In an embodiment the drive is positioned obliquely outwardly from the mandrel/conveyor plane. This will increase the spacing between the drives, reducing interference of the sleeve during discharge/ejection onto the object.

Preferably the mandrel has a single axial direction and comprises a straight tubular outer surface. However other embodiments are possible within the scope of protection.

In an embodiment the mandrel comprises an upstream tip for opening the foil, a sleeve cutting part and a downstream sleeve discharge part.

According to an embodiment a distance between the first (cutting) and second (engage for discharge) position is more than the predetermined sleeve length. Foil is fed over the mandrel and beyond the cutting device. By feeding in the axial direction foil of predetermined sleeve length beyond the first position, cutting at the first position results in an individual sleeve of predetermined length. As the sleeve discharge unit engages the sleeve at the second position, positioned further downstream than the predetermined sleeve length, the sleeve discharge unit is allowed to engage the sleeve only after cutting.

In an embodiment the sleeving device comprises at least a sleeve transporter for transporting the sleeve in the axial direction over the mandrel, the transporter positioned downstream from the cutting device and arranged at least to transport the individual sleeve into the sleeve discharge unit. According to the invention an auxiliary sleeve transporter is provided between the cutting device and discharge device to allow transporting the sleeve from the first position to the second position. The sleeve transporter is arranged downstream from the first position and is arranged to engage the foil fed beyond the first position.

In an embodiment the sleeve transporter, preferably a roller, is positioned a small distance downstream from the first position. The sleeve transporter can pull the foil/sleeve beyond the cutting device.

In embodiment the roller has an axis of rotation extending substantially perpendicular to the axial direction of the mandrel. Such a sleeve transporter is arranged to transport the sleeve in an axial direction of the mandrel, without twisting the sleeve/foil.

In an embodiment the sleeve discharge unit comprises at least a transport roller, preferably mounted on the mandrel, having an axis of rotation extending at an angle of 20-85, preferably 40-70 degrees to the axial direction of the mandrel. Such an angle allows discharging the sleeve in an axial direction while imparting a rotational movement to the sleeve. In an embodiment at least two transport rollers are mounted on the mandrel on opposite sides thereof.

In an embodiment the outer surface upstream from the sleeve discharge unit extends over more than 20% of the predetermined sleeve length, preferably more than 40%, having a smaller circumference than the circumference of the mandrel close to the cutting device. This will allow cancelling some of the twist in the sleeve. Explicitly this aspect/feature can be the subject of a divisional application, even when the foil is engaged by the discharge unit prior to cutting. Over the surface of smaller circumference twists are allowed to form. The foil is twisted. The twisting is absorbed in the foil fed over the smaller circumference. The twisting is not allowed to reach the blade clearance as the part fed of the surface of larger circumference lacks space for forming the twists.

In an embodiment the mandrel comprises a blade clearance to allow cutting the sleeve fed around the mandrel. The first position is located within the blade clearance, in particular in the centre of the blade clearance.

According to another aspect of the invention a mandrel to be suspended in a sleeving device for arranging sleeves around products, such as containers, is provided. In an embodiment the mandrel arranged for opening a foil to form a sleeve, the mandrel having a substantially tubular outer surface around which foil is fed. According to an embodiment the mandrel has at a first position a blade clearance to allow cutting of the foil to form individual sleeves of predetermined length. In an embodiment the outer surface of the mandrel has a first circumference upstream from the blade clearance.

In an embodiment the mandrel has, downstream from the blade clearance, a sleeve discharge unit for discharging or shooting sleeves in the axial direction from the mandrel over the product and arranged for imparting a rotational movement to the sleeve around an axial axis, the sleeve discharge unit engaging the individual sleeve at a second position.

In an embodiment the first circumference of the mandrel is larger than a second circumference of the outer surface of the mandrel downstream from the blade clearance.

Upstream from the first position the circumference of the outer surface of the mandrel is close to the inner circumference of the sleeve/foil fed around the mandrel. This outer surface is arranged to provide radial positioning of the foil providing and maintaining tension in the foil when the foil is fed over the blade clearance. Further downstream towards the second position the circumference can be reduced, allowing e.g wrinkling of the foil. By providing extra tolerance as a result of the reduced circumference, small deviancies can be countered using foil properties. In the end the cutting result, less pigtails, is improved.

In an embodiment the first circumference and the second circumference are circumferences of parts of the outer surface of the mandrel extending in the axial direction having a generally constant circumference. The mandrel can have tubular parts extending over a distance in the axial direction having a constant circumference. The outer surface part downstream from the blade clearance has a smaller circumference.

In an embodiment the mandrel comprises a diaphragm upstream from the blade clearance, wherein the first circumference is between 95%-99.9%, preferably 98-99.9% of a circumference of the diaphragm. Preferably the first circumference will be between 99% and 99.5% of the circumference of the diaphragm. Such an outer surface having a circumference close to the inner circumference of the foil will provide radial positioning of the foil and tension in the foil reducing the formation pigtails during cutting.

In an embodiment the second circumference is between 90%-99.5% of the circumference of the diaphragm. Preferably the second circumference is 95%-99% of the diaphragm circumference. The second circumference will allow more space in order to reduce friction as a result of spinning the sleeve during ejection.

In an embodiment the mandrel comprises a supply unit for supplying foil, the supply unit comprising at least a transport roller positioned downstream from the diaphragm and upstream from the blade clearance. This transport roller will draw the foil over the diaphragm.

In an embodiment the mandrel comprises a transport roller between the blade clearance and the sleeve discharge unit. The transport roller allows transporting the sleeve into the discharge. The transport roller can prevent twisting of the foil/sleeve when engaged by the rotational sleeve discharge unit to 'reach' the blade clearance/first position, as the transport roller provided an outwardly directed tension on the inner surface of the foil.

In an embodiment the mandrel has a necking-in. In an embodiment the mandrel comprises a foil wrinkling space. This foil wrinkling space, including the second position, allows twisting of the foil e.g. as a result of the engaging of the foil by the sleeve discharge unit, specifically the rotational sleeve discharge unit. The foil wrinkling space extends from the second position upstream. The twisting is allowed of a limited distance upstream from the second position. The foil wrinkling space starts downstream from the necking-in.

In an embodiment the second circumference is more than 0.5%, preferably at least 1%, and in some embodiments more than 2%, smaller than the first circumference. This will allow sufficient space to allow the foil to freely absorb deficiencies without disrupting the cutting process.

In an embodiment circumferences of parts of the outer surface of the mandrel directly upstream and downstream of the blade clearance are generally equal. This provides a symmetrical arrangement around the blade clearance. This reduces the formation of pigtails during cutting.

In an embodiment the blade clearance comprises a chamfer on the downstream side or both sides of the blade clearance. The downstream chamfer allows guiding the cut foil towards the outer surface of the mandrel.

Preferably the circumference of the outer surface remains substantially constant over a part of the downstream end of the mandrel, downstream from the first position. In an embodiment a substantially constant circumference is maintained over more than 20%, preferably more than 30% of the distance between the first and second position. By maintaining the 'large' circumference the sleeve is supported closely in its tubular form close to the cutting device, preventing pigtails. Deficiencies are caught in the more downstream part, near the second position.

Preferably two mandrel parts form the downstream part of the mandrel from the first position, the two parts having different circumferences. The sleeve shot (downstream) part has a reduced circumference.

In an embodiment the discharge unit is arranged to impart a rotational movement to the sleeve during discharging. The outer surface at the second position has a smaller circumference than the outer surface close to the first position. The sleeve can twist over the smaller outer surface. If the sleeve twists, most twisting will occur over the smaller outer surface. This reduces the formation of pigtails during cutting.

In an embodiment the distance between first and second position is substantially equal to the desired length. The discharge unit will engage the foil prior to cutting. A rotational discharge unit can cause twisting. The reduced circumference limits the extent of the twisting of the foil. The larger circumference of the mandrel upstream from the first position prevents the twisting to reach the cutting device/first position.

In an embodiment the first and second position are separated by a distance that is larger than the predetermined length of the sleeves. This ensures that the sleeve discharge unit engages the sleeve only after cutting the sleeve, eliminating twisting of the sleeve and reducing the formation of pigtails during cutting.

In an embodiment the transport roller has an axis of rotation extending substantially perpendicular to the axial direction of the mandrel. The transport roller is arranged to impart an axial guidance to the sleeve/foil fed around the mandrel/transport roller, preventing the twisting of the foil/sleeve before or during cutting.

In an embodiment the sleeve discharge unit on the mandrel comprises at least a transport roller mounted on the mandrel having an axis of rotation extending at an angle of 20-70 degrees to the axial direction of the mandrel.

According to yet another aspect of the invention a method of arranging sleeves of predetermined sleeve length around products, such as containers, is provided. The method can comprise any of the features as disclosed in WO 2008/088210 A1, incorporated by reference. In an embodiment the method comprises feeding a foil over an outer surface of a mandrel in an axial direction, conveying products to align the products with the axial direction of the mandrel, cutting the foil fed around the mandrel at a first position, to form an individual sleeve of predetermined length and arranging the sleeve around the product by discharging the sleeve in axial direction from the mandrel over the product.

In an embodiment a circumference of the mandrel at the second position is smaller than at the first position.

In an embodiment the method relates to rotation sleeving, wherein discharging comprises rotating the sleeve around an axial axis. The angular momentum of the sleeve during discharging results in opening (or remaining open) of the sleeve during discharge and arranging around the product.

According to an embodiment the foil is fed a predetermined sleeve length beyond the first position. In an embodiment the predetermined sleeve length and the distance between the first and second position are similar.

In an embodiment only after feeding the foil the predetermined sleeve length beyond the first position the foil/sleeve is engaged for rotational discharging. The inventor discovered that rotating of the foil/sleeve on the mandrel prior to cutting results in twisting of the foil/sleeve around the mandrel. That in turn results in pigtails formed during cutting. During cutting tensions in the foil are cut, the foil moves somewhat and the start and end positions of the (one or a number of) knives of the cutting device in the foil are not the same resulting in small hooks, so called pigtails. According to the method rotating as part of discharging is provided only after cutting, preventing twisting of the foil/sleeve.

In an embodiment discharging comprises engaging the sleeve at a second position at a distance from the first position being more than the predetermined sleeve length. When the sleeve is cut, the foil is fed beyond the first position by a predetermined sleeve length. If that length is less than the distance between the first and second position, the foil/sleeve does not reach the discharging unit that provides the rotational movement.

In an embodiment the method comprises the step of moving the individual cut sleeve in the axial direction into engagement at the second position for discharging the sleeve. This extra step in the method prevents twisting and reduces the formation of pigtails.

It will be clear to the skilled person that the drawing shows only preferred embodiments, and that other embodiments fall within the scope of the invention. Although the drawing will show preferred embodiments, and the invention was described with the appended claims, it will be clear to the skilled person that the invention can encompass other features mentioned explicitly in this description, but also implicit features. It will be clear to the skilled person that any of these explicit or implicit features can be combined with features mentioned in this description or in the claims. Divisional applications directed at these features are possible.

Embodiments will now be described referring to the drawing, wherein:

FIG. **1** shows a partially open view of a sleeving device and a mandrel according to a first embodiment,

FIG. **2** shows a partially exploded view of a mandrel according to the first embodiment;

FIGS. **3** and **4** show details of the mandrel of the first embodiment according to III and IV respectively,

FIG. **5** shows a detailed view of the mandrel according to the first embodiment according to V,

FIG. **6***a-c* shows five steps of the method according to three embodiments,

FIG. **7** shows a side view of a sleeving device according to another embodiment,

FIGS. **8**A-**8**F show embodiments of a cross-section of a mandrel for a sleeving device,

FIG. **9** shows another embodiment of a mandrel,

FIG. **10** shows a schematic overview of a system for sleeving a product comprising a sleeving device, and

FIG. **11** shows a further embodiment of a mandrel.

FIG. **1** shows a mandrel **1** for opening a foil **3**, shown with dotted lines. Foil **3** is provided as a flat envelop. The mandrel will open the envelope into a tubular envelope form. Individual sleeves can be cut from the foil and these sleeves are arranged around products. (not shown in FIG. **1**). In any of the examples the mandrel can have a spreader, preferably near an upstream end. The spreader is arranged to open the foil.

In this application "sleeve" is used as an indication for the individual sleeves that are arranged around products. In an embodiment sleeves are fed to the sleeving device. "Foil" is used as indication of a continuous strip of envelope material from which sleeves are to be cut.

The sleeving device is shown only partially in FIG. **1** in order to allow an open view of the mandrel **1**. Frame **4** is part of the sleeving device frame that allows mounting several elements of the sleeving device. Mandrel **1** is suspended in a sleeving device. Transport roller **6** is arranged to suspend the mandrel **1**. In any of the examples one or more rollers of the mandrel can engage rollers of the sleeving device such that the mandrel is suspended.

FIG. **1** shows the sleeving device having transport rollers **6**,**7**,**8**, discharge unit **9** and cutting device **10**. Transport rollers **6**,**7** and **8** comprise a couple of rollers **6***a*,**6***b*,**7***a*, **7***b*, **8***a*, **8***b* positioned on opposite sides of the mandrel **1**. Transport rollers **6**,**7** and **8** are part of a foil supply or transport unit for feeding foil over the mandrel. Further feeding units can be provided upstream from the mandrel, such as a buffer for foil.

Foil **3** is fed from a reservoir, such as a roll. Foil is winded onto the roll and unwounded during supply to the sleeving device. Further upstream elements not shown in FIG. **1** can be a buffer for providing a continuous supply of foil, even when replacing the reservoir/roll, and further guides for positioning the foil **3**, see e.g. FIG. **10**.

Foil **3** is provided as a flat continuous film comprising two layers of plastic connected and folded at corners **36**,**37**. In the transition from flat form to tubular form, most resistance against this opening will come from corners **36**,**37**, as will be illustrated in FIG. **8***a*.

FIG. **8***a* shows a cross section of a partially opened foil **3** comprising two layers **301**,**302**. The tip **31** of the spreader in the sleeving device will open the foil first in the middle part. The mandrel provides an opening force in the directions **303**,**304**. Corners **305**,**306** will move inwards.

Foil **3** is opened and fed over the outer surface of the mandrel **1** according to arrow **12**. The foil is fed from top to bottom and the top is the upstream end. The foil **3** is fed between the transport rollers **6**,**7**,**8** and transport rollers **16**,**17**, **18** mounted on the mandrel. The transport rollers **6**,**7**,**8** can be connected to a drive, in some embodiments via a transmission to a single drive, for driving the rollers. The drive can comprise a controller for detailed control of the motion of the foil fed over the mandrel **1**. An embodiment for the control and method of control is described referring to FIGS. **6***a*-**6***c*.

The mandrel **1** comprises an upstream opening part, spreader **21** for opening the foil **3**, a cutting part **22** and a downstream sleeve shooter part **26**. The cutting part **22** comprises a diaphragm **23** and a blade clearance **24**.

Diaphragm **23** is, in the embodiment according to FIG. **1**, the part of the mandrel **1** having the largest outer circumference of the tubular outer surface of the mandrel **1**. The outer circumference of diaphragm **23** is very close to the inner circumference of the foil **3**. The diaphragm **23** can comprises a chamfer like outer edge for contacting the foil. The edge of the diaphragm **23** can be in point contact with the foil. The foil is fed over the diaphragm, the diaphragm having, in an example, a close to circular, at least tubular cross section. Diaphragm **23** therefore provides an outward force on the foil **3**, tensioning the foil and supporting the tubular form of the foil around the mandrel. This tubular tension is maintained in the foil transferred over the diaphragm **23** more downstream.

The diaphragm **23** has an outer circumference that is 0.3 mm, preferably about 0.6 mm, or more larger than the outer circumference of the mandrel parts upstream and downstream from the diaphragm **23**. Other parts of the mandrel can have an even larger difference in circumference.

Blade clearance **24** allows cutting of the foil to form individual tubular sleeves. Cutting device **10** is shown schematically around the blade clearance and can comprise one or several, in particular four, actuated cutting knives. When actuated, the knives perform a cutting motion through the blade clearance **24**, for example a rotational movement cutting the foil.

A further downstream part of the mandrel is formed by the shooter part **26** comprising, amongst others, sleeve discharge unit **9**,**19** for ejecting the sleeve from the mandrel over the product and static charge collector **28**.

In this embodiment tip **31** is the most upstream part of the mandrel **1** and foil **3** is fed around this tip **31** thereby opening the foil **3** and positioning tip **3** in the envelope of the foil. The opened foil **3** will have a tubular form when the foil **3** is fed further downstream over the opening part **21** of the mandrel **1**. Foil **3** will take a generally cylindrical form. Transport rollers **6** and **16** are driven and will pull foil **3** over tip **31** in between the rollers **6** and **16** and convey foil **3** according to arrow **12**. The transport direction **12** is parallel to the axial direction **35** of mandrel **1**.

In the sleeving device the opened foil **3** is fed around the outer surface of the mandrel **1**. Foil **3** is transported between transport rollers **6**,**16**. Foil **3** will reach diaphragm **23**.

In the embodiment according to FIG. **1**, and as shown in more detail in FIG. **2**, the diaphragm **23** is positioned at an upstream tip of mandrel body **40** and mandrel body **41**. The outward position of the diaphragm **23** and the mandrel body **40**,**41** on which it is mounted, are, in this embodiment, strictly related, as they are part of the same integral body.

The mandrel bodies **40**, **41** are shown in FIG. **2**, wherein mandrel body **40** is shown with a dotted line. Mandrel bodies **40**,**41** together form the outer surface around which the foil **3** is fed. The surface of mandrel bodies **40**,**41** form outer surfaces of opposite sides of the tubular outer surface. The outer surface, according to this application, is the surface of the mandrel having an elongated tubular form. It has a surface area extending in the angular direction and in the axial direction **35**.

The mandrel bodies **40**,**41** comprise opening **43**. Opening **43** receives roller **17***a* mounted on the shaft of the mandrel **1**. Opening **43** is formed between the two mandrel bodies **40**,**41**. Rollers **7***a*,**7***b* and rollers **17***a*,**17***b*, as shown in FIG. **5**, are beared on the frame **4** and mandrel **1** respectively having an axis of rotation perpendicular to the axial direction **35** of the mandrel **1**. A foil fed between the rollers **7***a*/**7***b* and rollers **17***a*/**17***b* is transported in the axial direction **35**.

As transport rollers **17**,**7** are positioned downstream from diaphragm **23**, foil **3** is drawn over the diaphragm **23** when transport roller **7**,**17** are driven. Transport rollers **7**,**17** are mounted downstream from diaphragm **23** and upstream from blade clearance **24**.

The transport rollers **6**,**16** and transport rollers **7**,**17** are mounted with respect to tip **31** such that corners **36**,**37** are fed between the respective transport rollers mounted in the frame and transport rollers mounted in the mandrel. This will lead to extra deformation of the corners **36**,**37** when fed over the mandrel **1**. The corners are "squeezed" between the respective transport rollers **6**,**7** mounted on the frame **4** and transport rollers **16**,**17** mounted on the mandrel **1**.

Cutting device **10** surrounds the mandrel **1** and is arranged for cutting the foil **3** as fed around the outer surface at position **50** along the complete circumference of the sleeve.

Mandrel body **40** is biased outwardly according to arrow **51** as shown in FIG. **4** by a spring **52** mounted between mandrel bodies **40** and **41** around a pin **53**. Outward bias according to this application comprises a bias that results in an outward directed movement of the mandrel body.

In an embodiment the bias is provided using repulsive magnets mounted on mandrel and on the frame. In an example pneumatic elements are used for providing outward bias.

The outer surface of mandrel body **40** is part of the same body that comprises the diaphragm **23**. The outwardly directed force **51** will force the diaphragm **23** onto the inner surface of the foil **3**. The outward biasing force is strong enough to resist some inward pressure exerted by the foil on the diaphragm. On the other hand, the biasing force is small enough to allow inward/outward movement of the mandrel body as a result of e.g. a local reduction of the inner circumference of the foil **3** at the diaphragm **23**. As the diaphragm is the most outwardly extending fixed part of the mandrel body **40**,**41**, the outward position of the mandrel body is guided by the actual (instantaneous) circumference of the foil **3** at the diaphragm **23** of the machine in operation.

Most surface, e.g. surface part **25**, of mandrel body **40** is positioned at a radial distance more inward from the diaphragm **23**, e.g. at least 0.05 mm to 0.70 mm, more preferably from 0.10 mm to 0.35 mm. This allows the outer surface of the mandrel body **40** to still provide radial support, but also some space to feed the foil at a small distance from said surface, lowering transport resistance. The outer surface of the mandrel body **41** has a radius **55** as indicated in FIG. **5** although non circular mandrel bodies and outer surfaces also fall within the scope of this invention.

In an embodiment the transport rollers **17** are mounted to the mandrel body and will move in fixed relationship.

Mandrel bodies **40** and **41** are mounted on the mandrel. In an embodiment one of the bodies is an integral part of the frame of the mandrel **3**, see e.g. FIGS. **8***b*-**8***e*. In the embodiment as shown in FIGS. **1-4**, the two mandrel bodies **40**,**41** are mounted around central shaft **140**. Shaft **140** connects the sleeve shot part **107** and tip part **21** for opening the foil **3**.

Mounted on the shaft **140** are transport rollers **17**. Mounted on the shaft is a frame **141** comprising a shaft **142** over which rollers **17***a* and **17***b* are beared.

Mandrel bodies **40**,**41** can be mounted to the shaft **140** in several manners. In the embodiment according to FIGS. **1-4**, upstream and downstream ends of the mandrel bodies **40**,**41** comprise a pin **144** and a hole **145**. Both the sleeve shot part **107** and the downstream end of the mandrel tip part **21** also comprise a pin **147** and a hole **148**. Pins **144**,**147** comprise a biased ball **149** that is biased in an outward direction **139**. The mandrel body **40**,**41** can be mounted between the fixed tip **21** and sleeve shooter part **107** by moving the mandrel body between tip **21** and part **107**, wherein ball **149** is received in a respective hole. This embodiment allows fast radial replacement of mandrel bodies.

The ball **149**/hole **144**,**148** suspension of the mandrel bodies **40**,**41** allows both mandrel bodies to move somewhat in outward directions with respect to shaft **140**. The outward bias provided by spring **52** will force the mandrel bodies away from each other. Other embodiments for mounting the mandrel bodies **40**,**41** in the mandrel still allowing the outwardly biased arrangement are possible.

FIGS. **8***b*-**8***f* show in cross section different embodiments of mandrel bodies suspended in the mandrel. FIG. **8***b* shows an embodiment wherein a part **201** similar to shaft **140** is an integral part of mandrel body **202**. Mandrel body **203** is movably mounted in the mandrel around an axis **204**. Axis **204** can be a shaft connected to the tip **21** and sleeve shot part **107**. The axis **204** allows rotation of mandrel body **203** according to arrow **205** and shown with dotted lines. An outward bias is provided that biases the mandrel body **203** away from the mandrel body **202**. When foil **3** is fed around the mandrel bodies **202**,**203**, the mandrel bodies outer circumference will depend on the actual inner circumference of the foil **3** fed to the mandrel. As a result of the outward bias, the circumference of the outer surface will automatically adapt to the actual circumference of foil fed around the outer surfaces.

In examples of the invention a part of the mandrel carrying the diaphragm is biased outwardly. Thus the mandrel will provide an outward tension in the tubular foil. In further examples the same part of the mandrel also comprises a tubular outward surface for guiding the foil over the mandrel, the tubular section having a circumference that is smaller than the circumference of the diaphragm.

FIG. **8***c* shows an embodiment comprising two mandrel bodies **210**,**211** both mounted hingeable in the mandrel around an axis of rotation **212**,**213** respectively. An outward bias is provided e.g. using repulsing magnets that force the mandrel bodies **210**,**211** away from each other in the outward direction.

FIG. **8***d* shows an embodiment with a single mandrel body **220** comprising a part **221** similar to shaft **140**. Mandrel body **220** has two arms **222**,**223**. Arms **222**,**223** form the outer surface of the mandrel over which the foil is fed. The arms **222**,**223** can comprise an elastic material that is biased outwardly or a biased element is used to force the arms **222**,**223** to bend outwardly as indicated by the dotted lines. Again the circumference of the outer surface of the mandrel is adapted to the inner circumference of the actual foil being fed over the mandrel.

FIGS. **8***e* and **8***f* show further embodiments. Mandrel body **202** is connected to a mandrel **230** that is mounted to the mandrel having a single degree of freedom in direction **234**. A suitable guide, such as pins or rails, is used to allow such relative movement. In FIG. **8***f* both mandrel bodies **231**,**233** can move according to direction **234** with respect to the central shaft **232**.

The outward bias according to the application is arranged such that the mandrel bodies forming a substantial part of the outer surface of the mandrel, and comprising specifically the diaphragm, can move from the solid line position to a dotted line position in FIGS. **8***b*-**8***f*, increasing the circumference. Preferably the bias results in substantially equal outward movement for the two or more mandrel bodies.

Turning to FIGS. **1-5**, mandrel bodies **40** and **41** both form the outer surface of a substantial part of the mandrel. In the embodiment of FIGS. **1-5** the mandrel bodies form the outer surface of the mandrel both at an upstream side **60** and a downstream side **61** from the blade clearance **24**. As these surface **60**,**61** are part of the same moveable mandrel body, their relative outward position is directly linked.

Preferably the outer surfaces on both sides of the blade clearance **24** have an equal radius/circumference. This results in a symmetrical arrangement on both sides of the blade clearance **24** or first position **50**. The symmetrical arrangement will improve the result of the cutting with the cutting device **10**, e.g. by the reduction of the formation of pigtails.

As the mandrel outer surface **60** and **61** on both sides of the blade clearance **24** will provide stable support, cutting is also supported and formation of pigtails is reduced.

On both the upstream and downstream end chamfers **62**,**63** are formed as part of the blade clearance **24** to allow guidance of the foil **3** after cutting over the downstream outer surface **61** of the mandrel **3**. The chamfers **62**,**63** are symmetrically formed in order to obtain a symmetrical arrangement with respect to the first position **50**.

Foil **3** is fed a predetermined length beyond the first position **50**. In an embodiment the transport of the foil is stopped. During the transport pause cutting device **10** cuts the foil **3** at the first position **50**, forming an individual sleeve **70** having a cut length or predetermined length **71**.

Further downstream transport rollers **18** and **8** are provided again having a rotational axis perpendicular to the axial direction **35** of the mandrel **1**. Transport rollers also provide an axial guidance for the foil **3** fed beyond the blade clearance **24** or for the individual sleeve **70** having a cutting length or predetermined length **71**.

The sleeve **70** is transported further downstream to the discharge part **26**. The sleeve **70** is at first still supported by outer surface **61** of the mandrel body **40** and **41** downstream from the blade clearance **24**. Further downstream the sleeve inner surface is supported by the outer surface of sleeve shot part **81**. Sleeve shot part **81** preferably comprises a tubular outer surface of desired shape, in FIG. **1** a circular cross section.

The sleeve shot part **81** can have a circumference smaller than the circumference of mandrel bodies **41**,**42**. Transport of the sleeve **70** is not hindered in this manner. Sleeve shot part **81** is connected to the downstream end of the mandrel **3** and can comprise transport rollers **19** that cooperate with discharge rollers **9**. Rollers **9** and **19** together form the discharge unit. The axis of rotation **90**, in FIG. **1** positioned at an angle 50° with respect to the axial direction **35**, allows the discharge unit to engage the sleeve **70** at a second position **91** and provide a downward impulse combined with a rotational motion according to arrow **92** to the sleeve.

The sleeve **70** is shot in the axial direction **35**. The angular speed results in spinning around the axial direction.

Other embodiments of the discharge unit to provide an angular momentum to the sleeve comprise water jets or pressured air directed at an angle towards the sleeve shot part.

First position **50** is the position of the sleeving device where blade or knives of the cutting device **24** will cut the sleeve. Second position **91** is the position at which the discharge unit **9**/**19** will engage the sleeve **70** in order to start the discharge or eject the sleeve from the mandrel.

In accordance to some embodiments the predetermined length **71** of the sleeve **70** is about equal to the distance **94** between the first and second position. The discharge unit **9**/**19** would engage the sleeve **70** already before cutting.

In the embodiment of FIG. **1**, the predetermined length **71** or cutting length of the sleeve **70** is smaller than the distance between the first position **50** and second position **91**. Foil **3**/sleeve **70** is fed beyond the first position **50** by the predetermined length, without being engaged at the second position by the discharge unit **9**/**19**. The foil **3**/sleeve **70** is fed only in an axial direction prior to cutting. This will result in less pigtails as engagement by the discharge unit could result in twisting of the sleeve.

The transport rollers **8**,**18** engage the sleeve **70** after cutting and can transport the sleeve into the discharge unit **9**/**19**. In the shown embodiment the 'engaging after' is the result of the distance between the first and second position.

As the sleeve shot part **81** has a smaller circumference, this provides extra space/less support to the sleeve **70** when conveyed into the discharge unit **9**/**19**. As the discharge unit **9**/**19** provides an angular momentum to the sleeve when shot, this extra space can be used to allow some twisting of the sleeve **70** around the mandrel **1**.

Now an embodiment of a part of a method for sleeving products will be described in combination with FIG. **6***a*. FIG. **6***a* shows schematically four steps in the sleeving process according to an embodiment in combination with control signals provided to a drive controller for each the transport rollers. FIG. **6***a* shows three sets of transport rollers S**1**,S**2**,S**3**. Transport rollers S**1**,S**2**,S**3** correspond with transport rollers **7**,**8**,**9** respectively.

Transport rollers S**1** and S**2** will feed a foil **401** around mandrel **403**. Transport rollers S**1** and S**2** will drive the foil in the axial direction **404**. Transport rollers S**3** are sleeve transfer rollers and are part of the discharge unit for ejecting a sleeve of predetermined length from the mandrel over a product **445** aligned with the axial direction.

In this example the circumference of the outer surface of the mandrel **403** is substantially equal at upstream and downstream sides of the blade clearance **405**. In FIG. **6***a* a diameter **410** is indicated, although the invention is not limited to circular cross sections. The circumference of the sleeve shot part **411** near the discharge unit and transport rollers S**3** (second position) is smaller than the first circumference of the outer surface upstream from the blade clearance **405** (first position). Close to the blade clearance the outer surface upstream from the blade clearance provides support to the foil by having a circumference only slighter less than the circumference of the foil, resulting in tubular tension similar to the tension from the diaphragm in the foil, which reduces deformations during cutting. Near the discharge unit S**3**, the circumference, directly dependent on diameter **412**, the sleeve/foil is less supported to allow rotation of the sleeve around its axial direction.

For clarity the charge collector is not shown in FIG. **6***a*. Also not shown are transport rollers on mandrel **403** opposite the transport rollers S**1**,S**2**,S**3**. Although transport rollers S**1**,S**2**,S**3** are shown at the same opposite sides of the mandrel, it will be clear that they can be positioned at different sides.

Mandrel **403** has blade clearance **405** at first position **406**. A cutting device similar to FIG. **1** is mounted on the frame of the sleeving device near first position **406** and allows cutting.

At step **1** as shown in FIG. **6***a* foil **401** is transported beyond first position **406** by a predetermined length **415**. To allow transporting of the foil **401**, S**1** and S**2** (or respective drivers) are provided with a control signal **420**,**421** respectively. In this embodiment the motion of the foil **401** is stopped when the predetermined length **415** is transported beyond first position **406**. Between step **1** and step **2** the foil **401** is cut and a sleeve **423** of predetermined length is formed. Cutting by cutting device is controlled by a signal **424** as indicated in FIG. **6***a*.

After step **2**, before step **3**, foil **401** is transported over the mandrel **403**. S**1** is driven, with a control signal **422**. Sleeve **423** is transported downwards over the mandrel. S**1** will transport foil of predetermined length beyond first position **406**. Transport roller S**2** pushes the sleeve axially towards the downstream discharge unit S**3**. Discharge unit S**3** engages the sleeve at the second position **442**. The distance **441** between S**2** and S**3** is somewhat smaller than length **415**. During transport of the sleeve **423** the sleeve is engaged by either transport roller S**2** or S**3** or both.

At step **3** the foil **423** already reached S**3** and is engaged by transport rollers S**3**. Transport rollers S**3** drive the sleeve **423** in the axial direction and will impart a rotation movement according to arrow **429**. Driving of transport rollers are controlled with control signal **430**.

As transport rollers S**3** will impart two types of motion onto the sleeve, the drive energy is higher than transport rollers S**1**,S**2**. If the angle between axial direction and axis of transport rollers S**3** decreases, the rotational speed of S**3** is increased.

Although in this embodiment the foil **403** and sleeve **423** are transported with a similar speed, it is possible to move the sleeve **423** with a higher speed directly after cutting.

In this embodiment, as soon as transport rollers S**2** do not engage the sleeve **423** anymore, directly after step **3**, the transport rollers S**3** are driven at a much higher speed, indicated in signal **430** with a high peak **444** directly after **3**. During the peak **444** both the axial movement of the sleeve **423** and its rotational speed are increased substantially. This allows arranging the sleeve **423** around product **444** aligned with the axial direction of the mandrel, conveyed by a conveyor (not shown in FIG. **6***a*.)

Simultaneously with discharging foil **403** is moved the predetermined length and at step **4** the process is repeated.

A further embodiment for a method for sleeving products will be described in combination with FIG. **6***b*. FIG. **6***b* shows schematically four steps in the sleeving process according to an embodiment of the invention in combination with control signals provided to a drive controller for each the transport rollers. FIG. **6***b* shows two sets of transport rollers S**11**,S**13**. Transport rollers S**11**,S**13** correspond with transport rollers **7**,**9** respectively.

Transport rollers S**11** will feed a foil **1401** around mandrel **1403**. Transport rollers S**11** will drive the foil in the axial direction **1404**. Transport rollers S**13** are part of the discharge unit for ejecting a sleeve of predetermined length from the mandrel over a product **1445** aligned with the axial direction.

The circumference of the outer surface of the mandrel **1403** is substantially equal at upstream and downstream sides of the blade clearance **1405**. In FIG. **6***b* a diameter **1410** is indicated, although the invention is not limited to circular cross sections. The circumference of the sleeve shot part **1411** near the discharge unit (second position) and transport rollers S**13** (is smaller than the first circumference of the outer surface upstream from the blade clearance **1405** (first position). Close to the blade clearance the outer surface provides support to the foil, which reduces deformations during cutting. Near the discharge unit S**13**, the circumference, here indicate with diameter **1412**, the sleeve/foil is less supported to allow rotation of the sleeve around its axial direction.

For clarity the charge collector is not shown in FIG. **6***b*. Also not shown are transport rollers on mandrel **1403** opposite the transport rollers S**11** and S**13**. Although transport rollers S**11**,S**13** are shown at the same opposite sides of the mandrel, it will be clear that they can be positioned at different sides.

Mandrel **1403** has blade clearance **1405** at first position **1406**. A cutting device similar to FIG. **1** is mounted on the frame of the sleeving device near first position **1406** and allows cutting.

At step **1** as shown in FIG. **6***b* foil **1401** is transported beyond first position **1406** by a predetermined length **1415**. To allow transporting of the foil **1401**, rollers S**11** (or respective drivers) are provided with a control signal **1420**.

In this embodiment the motion of the foil **1401** is stopped when the predetermined length **1415** is transported beyond first position **1406**.

Between step **1** and step **2** the foil **1401** is cut and a sleeve **1423** of predetermined length is formed. Cutting by cutting device is controlled by a signal **1424** as indicated in FIG. **6***b*.

After step **2**, during step **3**, foil **1401** is transported over the mandrel **1403**. S**11** is driven, signal **1422**. Sleeve **1423** is transported downwards over the mandrel. Foil **1401** can push the sleeve or the sleeve **1423** can fall downward after cutting the foil. S**11** will transport foil of predetermined length beyond first position **1406**.

Discharge unit S**13** engages the sleeve at the second position **1442**. As the distance between the first position **1406** and second **1442** is more than length **1415**, sleeve **1423** is unengaged some time.

At step **3** sleeve **1423** already reached S**13** and transport rollers S**13** engage on an outside surface of the sleeve, clamping the sleeve **1423** in between the rollers S**13** and outer surface **1411** of the mandrel. Transport rollers S**13** drive the sleeve **1423** in the axial direction and will impart a rotation movement according to arrow **1429**. Driving of transport rollers can be controlled with control signal **1430**.

As transport rollers S**13** will impart two types of motion onto the sleeve, the drive energy is higher than transport rollers S**11**. If the angle between axial direction and axis of transport rollers S**13** decreases, the rotational speed of S**13** is increased.

In this embodiment foil **403** pushes sleeve **423** towards the discharge unit/second position.

In this embodiment already before step **3**, the transport rollers S3 are driven at a much higher speed, indicated in signal **1430** with a high peak **1444**. During the peak **1444** both the axial movement of the sleeve **1423** and its rotational speed are increased substantially. This allows arranging the sleeve **1423** around product **1444** aligned with the axial direction of the mandrel, conveyed by a conveyor (not shown in FIG. **6***h* in or out of the plane of the paper of FIG. **6***b*).

Simultaneously with discharging foil **403** is moved the predetermined length and at step **4** the process is repeated.

In FIG. **6***b* drive units **1450**,**1451** of rollers **1452**,**1453** are shown on opposite sides of the mandrel **1403**. The drive units have a shaft **1454**,**1455** respectively. As the drive is controlled, shaft **1454**,**1455** will rotate and roller **1452**,**1453** will impart impulse onto the sleeve. The shaft axis is not positioned parallel to the mandrel axis and to the conveyor transport direction. The drive units are positioned downwardly and outwardly away from the mandrel, surrounding the conveyor and container **1445** passing underneath the mandrel **1403**. By positioning the drive units at an angle of at least 5 degrees with respect to the mandrel axis (or the plane of mandrel and conveyor), more space is created between the opposite drive units. The elongate drive units having the shafts **1454**,**1455** at one end, are positioned starting from an upright position tilting the bottom end outwardly follow by a rotation around the longitudinal axis of the drive units.

A further embodiment of a part of a method for sleeving products will now be described referring to FIG. **6***c* FIG. **6***c* is similar to FIGS. **6***a* and **6***b* in that it schematically shows four steps in the sleeving process according to an embodiment of the invention in combination with control signals provided to a drive controller for each the transport rollers. FIG. **6***c* shows two sets of transport rollers S**21**,S**23**. Transport rollers S**21**, S**23** correspond with transport rollers **7**,**9**.

Transport rollers S**21** feed a foil **2401** around mandrel **2403**. Transport rollers S**21** will drive the foil in the axial direction **2404**. Transport rollers S**23** are sleeve transfer rollers and are part of the discharge unit for ejecting a sleeve of predetermined length from the mandrel over a product **2445** aligned with the axial direction.

The circumference of the outer surface of the mandrel **2403** is substantially equal at upstream and downstream sides of the blade clearance **2405**. In FIG. **6***c* a diameter **2410** is indicated, although the invention is not limited to circular cross sections. The circumference of the sleeve shot part **2411** near the discharge unit and transport rollers S**23** is smaller than the circumference near the blade clearance **405**.

In fact the mandrel outer surface has a substantially constant circumference from the blade clearance **2405** until halfway to the roller S**23**. The second half, after the necking in, also has a substantially constant but smaller circumference, e.g. at least 1% smaller or preferably at least 5% smaller.

Close to the blade clearance the outer surface provides support to the foil, which reduces deformations during cutting. Near the discharge unit S**23**, the circumference, here indicated with diameter **2412**, the sleeve/foil is less supported to allow rotation of the sleeve around its axial direction.

Mandrel **2403** has blade clearance **2405** at first position **2406**. A cutting device similar to FIG. **1** is mounted on the frame of the sleeving device near first position **2406** and allows cutting.

At step **1** as shown in FIG. **6***c* foil **2401** is transported beyond first position **2406** by a predetermined length **2415**. The downstream end is barely engaged by rollers S**23**. To allow transporting of the foil **2401**, S**21** (or respective drivers) are driven using with a control signal **2420**.

In this embodiment the motion of the foil **2401** is stopped when the predetermined length **2415** is transported beyond first position **2406**.

Between step **1** and **2** the foil **2401** is cut and a sleeve **2423** of predetermined length is formed. Cutting by cutting device is controlled by a signal **2424**.

After step **2**, during step **3**, foil **2401** is transported over the mandrel **2403**. S**21** is driven, signal **2427**. S**21** will transport foil of predetermined length beyond first position **406**.

Sleeve **2423** is transported downwards over the mandrel engaged by discharge unit S**23** and will be ejected while rotating.

At step **3** transport rollers S**23** will continue to drive the sleeve **2423** in the axial direction and will impart a rotation movement according to arrow **2429**. Driving of transport rollers are controlled with control signal **2430**.

As transport rollers S**23** will impart two types of motion onto the sleeve, the drive energy is higher than transport rollers S**21**. If the angle between axial direction and axis of transport rollers S**23** decreases, the rotational speed of S**23** is increased. Signal **2430** with a high peak **2444** shows that larger rotational speed of discharge rollers S**23**. During the peak **2444** both the axial movement of the sleeve **2423** and its rotational speed are increased substantially. This allows arranging the sleeve **2423** around product **2444** aligned with the axial direction of the mandrel, conveyed by a conveyor (not shown in FIG. **6**.)

Simultaneously with discharging foil **2403** is moved the predetermined length and at step **4** the process is repeated.

FIG. **9** shows a side view of an embodiment of a device for the method according to FIG. **6***c*. The predetermined length or cutting length **101** of sleeve **102** is now substantially equal to the distance between first position **104** and second position **105**.

In FIG. **9** shooting or discharging the sleeve **102** is shown. Sleeve **102** is shown in a partially discharged position. Sleeve **102** is shot in the axial direction **109** and simultaneously provided with an angular momentum.

Sleeve **102** is transported along the charge collector **150** for collecting static electricity mounted near the downstream end of the mandrel.

Sleeve **102** will be arranged over a product **130**. Product **130** is one of a row of products **131** conveyed by a conveyor **132** in a direction **133**. Product **134** is already provided with an individual sleeve **135** of predetermined length. The conveyor **132** conveys the products under the mandrel and aligns the products with the axial direction of the mandrel. In an embodiment the products **131** are transported continuously.

In this embodiment the outer surface between the first and second position comprises two tubular surface areas of different circumference. These tubular surface areas are characterized by a substantially constant radius of the outer surface in the axial direction. The two tubular surface areas are separated by a necking-in.

Directly downstream from the blade clearance **24**, the outer surface is formed by bodies having a larger circumference than the tubular outer surface of the sleeve shot part **107**. In an embodiment the transition, here a necking-in, from larger to smaller circumference is positioned at about 30-70% of the predetermined length of the sleeve between the first and second position. Before cutting, the sleeve **70** is already engaged by discharge unit **9**/**19** and this will result in some twisting of the sleeve near the discharge unit **9**/**19**. However as the circumference of the outer surface **161** near the blade clearance **24** is only somewhat smaller than the inner circumference of the sleeve **70**, as a result of the outward bias, the twists in the foil **3**/sleeve **70** are only formed in the sleeve part surrounding the sleeve shot part **107** of smaller circumference. The space or tolerance between the circumference of the mandrel near the blade clearance **24** prevents twisting of the sleeve in that area. Without the twisting of the sleeve, even though the discharge unit already engages the sleeve before cutting, the sleeve can be cut with reduced formation of pigtails.

In the embodiment according to FIG. **9**, twists **110** are shown on the sleeve **102** in the part of the sleeve positioned downstream from transition **111**. Twists only arise in the sleeve surrounding the sleeve shot part **107**.

In yet another embodiment a further diaphragm is positioned downstream from the blade clearance **24** and upstream the discharge unit **9**/**19**. Such a diaphragm prevents twists from reaching the blade clearance **24**.

In the embodiment according to FIGS. **1**,**2** and **9** a charge collector **28**,**150** for collecting static electricity is positioned near the downstream end of the mandrel **3**. The static charge collector **28**,**150** comprises electrically conducting filaments **180** extending outwardly from a body **181** that can be mounted using pin **182** on the downstream end of the mandrel **31**. Sleeves **70**,**102** will pass the collector **28**,**150**. In an embodiment the filaments extend such that they are in contact with the sleeve.

Static electricity is collected also on the inside surface of the foil **3**. This static electricity can result in friction with or adhesion of the foil to other surfaces or can even provide a inward force bringing the foil back to the flat envelope shape.

The collector **28**,**150** mounted on the mandrel **1** is arranged to collect electrostatic charges present on the inside surface of the foil **3**/sleeve **70**. As the sleeve passes the collector **28**, charge collector **28**,**150** collects positive and negative charges present on the inside of the foil. The charges are transferred to charge collector elements, such as filaments **180**. Charge is collected on the filaments and distributed over the body **181** comprising a conductive material. The filaments can be electrically connected to each other and collected positive and negative charges will cancel out, already reducing the static charges present on the foil. In any of the embodiments the charge collector can be arranged to redistribute static charges on the inside surface of the foil.

The static charge can be electrically discharged, e.g. after shooting the sleeve in a subsequent step, preferably performed while no sleeve surrounds the collector **28**,**150**. FIG. **7** shows a side view. In an embodiment collector **28**,**150** comprises or is connected to a charge capacitor. In other examples the charge collector **28**,**150** is positioned more upstream and in an example an inside foil discharge unit comprising the charge collector for collecting charge from the inside of the sleeve is positioned in a foil supply unit, upstream from the mandrel.

Conveyor **132** supports a row of containers **131**. Sleeve **135** was shot around product **134**. Product **130** moved under the downstream end of mandrel **1** ready to receive sleeve **70** to be shot in direction **109**.

During the process of sleeving the product, during a small time span, collector is not surrounded by sleeves. A sharp tip **186** of a conductor **185** connected to the earth **187** formed by frame **4** of the sleeving device provides the possibility of electrically discharging the collected static charge from collector **28**.

As a result of the collected charge in collector **28**, a high electric field can be formed between tip **186** and filaments

180. This field will be high enough for a spark discharge **188** between collector **28** and tip **186**. A spark gap of several millimeters between collector **28** and tip **186** can remain. Electric fields of 1000V/mm can be obtained.

The figures show only a possible embodiment of the electrical discharge unit for static charge from the inner sleeve. The inside sleeve discharge unit comprises arranged on the mandrel, an electrical charge collector **28** comprising electrically conductive material. This material is at least arranged along a least a part of a circumferential surface of the mandrel. Preferably the material, e.g. filaments **180**, is directed outward from the body **181** of the collector. The collector can comprise a single layer of filaments extending outwardly or multiple layers as indicated in FIG. **1**.

As part of electrical discharge unit for static charge from the inner sleeve, the electrical discharger tip **186** is mounted on the frame. The tip is mounted at a short distance from a conductor connected to the collector on the mandrel, whilst the discharger is connected to the earth.

In an embodiment a current or charge meter is connected to the discharge for measuring the discharge current/charge. If the discharge is lower than a threshold, this can be an indication of wear of the collector.

In the embodiment according to FIG. **1**/**7** the discharger tip **186** and collector **28** are not connected directly. Removing the electrical charge according to an aspect of the invention comprises two subsequent steps: first removing the charge from the sleeve by collecting the static charge on the collector mounted on the mandrel, already comprising the cancelling out of opposite charges, and second removing the collected charge by electrical discharge via a conductor mounted on the frame.

With the static charge removed, charge collector **28** can collect a further static charge load from a next sleeve or from foil, if the charge collector is positioned more upstream.

Discharge tip **186** can comprise an actuator that forces the tip **186** to actually contact the collector/filaments during the period that no sleeve is present around the collector **28**. During passage of the sleeve, the actuator controls the discharge tip to move outwards to allow passage.

Although the discharge tip **186** is shown in FIG. **7** at the upstream side from mandrel **1** in relation to transport direction **133**, it is preferred also to position the discharge tip at one of the opposite sides along the transport direction **133**, in FIG. **7** in and out of the paper. As the sleeve is discharged in direction **109**, the sleeve could move in the downstream direction **133** due to the movement of product **130** and could collide with the discharge tip.

In some embodiments the static electricity collector is mounted more upstream. Still the discharge tip **186** can be positioned near the downstream end of the mandrel. The charge collector can comprises a conductor connecting the more upstream collector with a position near the tip of the mandrel, in the vicinity of the tip **186**. The collected electrical charge can still be removed by spark discharge.

In some embodiments the electrical spark discharge takes place through the foil **3**. If the foil comprises perforations, the spark is preferably discharged through those perforations. Discharge tip **186** can be positioned more upstream on one side of the foil **3**, while static electricity charge collector comprising filaments is positioned on the other inside of the foil **3**. Charge is collected and discharged through the foil when sufficient charge is collected.

Not shown, but possibly combined with any of the embodiments, is an electrical discharge unit for static charges from the outside of the sleeve. Such a static discharge unit can comprise electrical conductors mounted close or in contact with the outer surface of the foil **3** or sleeve **70**. The electrical conductors can comprise conductive filaments. Multiple filaments, directed inwardly, can be positioned around the sleeve passage. The charge collector can comprise a ring like conductor connected with the filaments. Collected charges can be discharged immediately as a permanent connection to the ground is available: the collector is mounted on the frame of the sleeving device.

The conductive filaments have a sharp tip. The arrangement of multiple electrical conductors on the charge collector **28** forms a multi needle structure of electrical conductors.

In an embodiment the charge collector comprises brushes or other embodiments as shown in U.S. Pat. No. 3,757,164, included by reference. Clearly the collector according to this invention can comprise any of the features, embodiments and specifically compositions of filaments known from U.S. Pat. No. 3,757,164.

FIG. **10** shows schematically a system for labelling containers. A foil roll **500** is provided in a foil stock **501**. The roll provides foil **502**. Foil is fed to a buffer **503**. Buffer **503** can buffer foil e.g. when a roll **500** is replaced, to provide a continuous feed to sleeving device **506** comprising a mandrel **507** and discharge units **508**. Sleeves **510** are cut and shot over containers **509** supported and conveyed by conveyor **512**. Containers are aligned with the discharge unit **508**. Conveyor **512** transports the sleeved containers further downstream e.g. into a steam oven **513**. Foil **502** is a heat shrink foil. The steam will shrink the sleeve and the sleeve is attached to the container, providing a labelled container **518**.

FIG. **11** shows a detail of a further example of the mandrel **800** according to the invention. In this example foil fed over the mandrel **800** is not shown. Foil would be supplied over the mandrel in a direction **818** downwardly. Mandrel **800** has a transport roller **816** positioned between diaphragm **804** and blade clearance **805**. Transport roller **816** can cooperate with a corresponding roller of the sleeving device in which the mandrel is mounted. The cooperating rollers sandwich the foil in between. The not shown transport roller of the sleeving device can comprise a drive. The roller is driven by a controller according to a suitable pattern. The rollers are arranged to mount the mandrel in the sleeving device. Foil is drawn over the diaphragm **804** by roller **816**. This prevents the formation of wrinkles in the foil or even the complete blocking of the supply of foil.

Diaphragm **804** will have a circumference C**1**. This circumference C**1** will correspond closely to the inner circumference of the foil fed over the mandrel. The radial positioning of the foil, forcing the foil radially outward in a tubular form, provides tension in the foil fed over the mandrel. In any of the examples described herein the mandrel can comprise a diaphragm **804** arranged to radially position the foil. In any of the examples the diaphragm **804** can be positioned upstream from the blade clearance **805**.

The outer surface **801** of the mandrel upstream from the blade clearance **805** has a first circumference C**2** that is close to but somewhat smaller than circumference C**1**. The outer surface **801** forms a part of the outer surface of the mandrel **800** extending over an axial distance. Here axial length **820** has a constant first circumference C**2**. In an embodiment the first circumference C**2** is at least 0.5% smaller than circumference C**1**, in an example at any position along the axial length **820**. The difference in radius is indicated by arrow **810**. As the first circumference C**2** is only somewhat smaller than the inner circumference of the foil fed over the mandrel, the outer surface **801** will provide radial positioning of the foil on the one hand, without significantly increasing the friction of the foil being guided over the mandrel **800**. In combination with the diaphragm the tension is maintained. In examples the first circumference is a circumference of the outer surface of the mandrel upstream from the blade, somewhat smaller than the diaphragm circumference, of the part of the outer surface providing radial positioning without significant friction.

In this example an upstream chamfer **806** and a downstream chamfer **807** are formed on the mandrel **800** directly upstream and downstream from the blade clearance. These chamfers **806**,**807** are not part of the outer surface and have a significant smaller circumference. Chamfers **806**,**807** are part of the blade clearance. Chamfer **807** is arranged to allow guidance of a foil end over the outer surface **802** of the further downstream part of the mandrel **800**. Chamfer **807** guides the foil outwardly in order to be fed over the outer surface. Chamfer **806** is formed in order to provide symmetry at the blade clearance resulting in fewer pigtails.

Although in other embodiments the circumferences of the outer surface **801**, **802** directly upstream and downstream respectively of the blade clearance **805** are generally equal, in the example of FIG. **11**, the circumferences C**2** and C**3** differ. Second circumference C**3** is smaller than first circumference C**2**, indicated by the radius difference **811**. The example of FIG. **11** is a less preferred example. The circumferences C**2**,C**3** of the outer surfaces **801**,**802** are preferably generally equal directly upstream and downstream from the blade clearance **805**/chamfers **806**/**807** to reduce the formation of pigtails. A symmetrical arrangement is preferred.

Further downstream, e.g. at a zone referenced by reference number **825** and positioned downstream from the blade clearance **805**, the sleeve length SL is indicated, the sleeve length corresponding almost with the distance between the blade and the discharge unit **830**. In the example of FIG. **11** sleeve length SL is somewhat smaller. Zone **825** is the area along 20%-80% of the sleeve length SL. In this zone the mandrel can be necked-in, similar to FIG. **6***a*, Circumference C**4** will be smaller than circumference C**3**.

In the embodiment of FIG. **11** the part of mandrel **800** downstream from the blade clearance **805** has an outer surface **802** having circumference C**3**=C**4**. The downstream part of the mandrel having outer surface **802** has a constant circumference. In other embodiments the outer circumference can vary.

The embodiment according to FIG. **11** allows cutting the sleeve having a predetermined sleeve length SL (after feeding the predetermined sleeve length beyond the blade clearance **805**) and allowing the cut sleeve to 'fall' into the roller **830** of the sleeve discharge unit **831**. Because outer surface **802** has a smaller circumference, the friction of foil sliding over the outer surface **802** is further reduced, allowing the foil to slide downward according to arrow **818** as a result of the force of gravity, contrary (or additionally) to examples of FIGS. **6***a*-**6***c*.

Sleeve discharge unit **831** is, in the shown embodiment, a separate part mountable to the end of the mandrel **800** downstream from outer surface **802**. In most embodiments it will have a circumference C**5** that is equal or smaller than circumference C**4**. However C**5** can be more than C**4**.

In an embodiment the roller **830** of the sleeve shot unit **830** can extend radially from the outer surface **832**, locally increasing the circumference over which the foil is to be fed. In accordance to this application, the increase in circumference as a result of the radial extension of a roller is not taken into account when assessing the second circumference **809**.

The position for determining the second circumference according to the invention is a preferably a position close to the second position, that is the position at which the foil is engaged by roller **830**.

In embodiment the circumference of the outer surface **802** only decreases downstream from the blade clearance **805**. This prevents hindrances in the foil feeding path.

It should be noted that, in combination with the outwardly biased mandrel bodies having the diaphragm, circumference C**1**-C**4** can vary as these circumferences are taken around the movable mandrel bodies.

Table 1 provides seven examples of combinations of:

C**0**=internal circumference of the tubular foil,

circumference C**1** at the diaphragm

(first) circumference C**2** between the diaphragm and blade clearance

circumference C**3** at about 10% of the sleeve length downstream from blade clearance **805**,

(second) circumference C**4** at about 80% of the sleeve length downstream from the blade clearance

and circumference C**5** of the outer surface of the discharge unit **830**, circumferences in mm:

TABLE 1

	C0	C1	C2	C3	C4	C5
E1	170	169.9	168.9	168.9	168.9	166.4
E2	194.8	194.7	193.7	193.7	193.7	191.6
E3	209.9	209.8	208.8	208.8	208.8	208.8
E4	229.9	229.9	228.9	228.9	225.7	224.8
E5	116	115.9	114.9	114.9	111.8	111.5
E6	431.9	431.8	430.8	430.8	427.7	426.7
E7	116	114.4	112.8	103.7	103.7	113.1

Any of the mandrel embodiments can be combined with different sleeve lengths. Specifically the arrangements having C**3**<C**2** have a discharge unit positioned such that a sleeve is engaged at more than a sleeve length distance downstream from the blade clearance. In the above examples C**4** and C**5** are between 0.8%-7% smaller than C**1**.

In any of the embodiment C**2** can be the first circumference, whereas any of the circumferences C**3**,C**4**,C**5** can be the second circumference.

Example E7 shows an example wherein the circumference at the discharge unit is increased in combination with a significantly reduced circumference in the downstream part from the blade clearance. Example E7 comprises a significant necking-in at C**3** and C**4** allowing the free fall of the sleeve, directly after cutting the predetermined length of sleeve from the foil. The sleeve will fall into the sleeve discharge unit.

Clearly many different embodiments are possible within the scope of the invention.

The invention claimed is:

1. Sleeving device for arranging sleeves of a predetermined sleeve length around products, such as containers, the sleeving device comprising:

a frame,

suspended to the frame, a mandrel configured to open the foil to form a sleeve, the mandrel having a substantially tubular outer surface around which foil is fed, the mandrel extending in an axial direction,

at least one feed unit configured to feed the foil to the mandrel,

at least a conveyor configured to transport products, such as containers, and to align products with the axial direction of the mandrel,

at least one cutting device configured to cut the foil fed around the mandrel at a blade clearance located at a first position to form individual sleeves having the predetermined sleeve length, and at least one sleeve discharge unit configured to discharge sleeves in the axial direction from the mandrel over the product, the sleeve discharge unit engaging the individual sleeve at a second position, wherein the sleeve discharge unit comprises a rotational sleeve discharge unit configured to impart a rotational movement to the sleeve around an axial axis,

wherein a first portion of the outer surface of the mandrel upstream from the blade clearance has a first circumference, the first portion configured to position the foil radially,

wherein a second portion of the outer surface of the mandrel downstream from the blade clearance has a second circumference that is smaller than the first circumference so as to form a foil wrinkling portion configured to allow twisting of the foil over a limited length of the foil, and

wherein the circumference of the outer surface of the mandrel downstream from the second portion does not enlarge.

2. Sleeving device according to claim **1**, wherein the second circumference is the circumference of the outer surface of the mandrel at a distance of at least 20% of the sleeve length downstream from the blade clearance.

3. Sleeving device according to claim **1**, wherein the first circumference and the second circumference are circumferences of parts of the mandrel each part having a generally constant circumference.

4. Sleeving device according to claim **1**, wherein the mandrel comprises a diaphragm upstream from the blade clearance, wherein the first circumference is between 98% to 99.9% of a circumference of the diaphragm.

5. Sleeving device according to claim **4**, wherein the second circumference is between 90% to 99.5% of the circumference of the diaphragm.

6. Sleeving device according to claim **4**, wherein the sleeving device comprises a supply unit configured to supply foil, the supply unit comprising at least a transport roller positioned downstream from the diaphragm and upstream from the blade clearance.

7. Sleeving device according to claim **1**, wherein the mandrel comprises a necking-in between the first and second position.

8. Sleeving device according to claim **1**, wherein the foil wrinkling portion is at least 1.4 cm^3.

9. Sleeving device according to claim **1**, wherein the second circumference is at least 0.5% less than the first circumference.

10. Sleeving device according to claim **1**, wherein circumferences of parts of the outer surface of the mandrel directly upstream and downstream of the blade clearance are generally equal.

11. Sleeving device according to claim **1**, wherein the blade clearance comprises a chamfer on the downstream side or both sides of the blade clearance.

12. Sleeving device according to claim **1**, wherein the circumference of the mandrel downstream from the first position remains constant from the first position in the axial direction towards the second position over a distance of at least 20% of a total distance between the first and second position.

13. Sleeving device according to claim **12**, wherein the total distance between the first and second position is about the predetermined length of the sleeve.

14. Sleeving device according to claim **12**, wherein the circumference of the mandrel downstream from the first position remains constant from the first position in the axial direction towards the second position over a distance of at least 40% of the total distance between the first and second position.

15. Sleeving device according to claim **1**, wherein the mandrel comprises at least two parts downstream from the first position, the parts extending in the axial direction each having a substantially constant circumference, wherein a downstream part has a smaller circumference.

16. Sleeving device according to claim **1**, wherein the rotational sleeve discharge unit comprises at least a transport roller mounted on the mandrel having an axis of rotation extending at an angle in the range of 20 to 85° to the axial direction of the mandrel.

17. Sleeving device according to claim **16**, wherein the rotational sleeve discharge unit comprises a drive, a driven shaft and a roller connected to the shaft and wherein the shaft is mounted under an angle of more than 5 degrees with respect to a plane of the mandrel and conveyor.

18. Sleeving device according to claim **12**, wherein the rotational sleeve discharge unit comprises at least a transport roller mounted on the mandrel having an axis of rotation extending at an angle in the range of 40 to 75° to the axial direction of the mandrel.

19. Sleeving device according to claim **1**, wherein the axial distance between the first and second position is smaller than the predetermined sleeve length.

20. Sleeving device according to claim **1**, wherein the axial distance between the first and second position is 80% of the sleeve length or less.

21. Sleeving device according to claim **1**, wherein the second circumference is the circumference of the outer surface of the mandrel at a distance of at least 60% of the sleeve length downstream from the blade clearance.

22. Sleeving device according to claim **1**, wherein the second circumference is the circumference of the outer surface of the mandrel at the second position.

23. Sleeving device according to claim **1**, wherein the foil wrinkling portion is positioned at and upstream from the second position, the foil wrinkling portion configured to allow twisting of the foil over a limited length of the foil upstream from the second position.

24. Mandrel to be suspended in a sleeving device for arranging sleeves around products such as containers, the mandrel arranged for opening a foil to form a sleeve, the mandrel comprising:

a substantially tubular outer surface around which foil is fed,

at a first position, a blade clearance configured to allow cutting of the foil to form individual sleeves of predetermined length, and

downstream from the blade clearance, a sleeve discharge unit configured to discharge sleeves in the axial direction from the mandrel over the product, the sleeve discharge unit also comprising a rotational sleeve discharge unit configured to impart a rotational movement to the sleeve around an axial axis, the sleeve discharge unit engaging the individual sleeve at a second position,

wherein a first portion of the outer surface of the mandrel upstream from the blade clearance has a first circumference, the first portion configured to position the foil radially,

wherein a second portion of the outer surface of the mandrel downstream from the blade clearance has a second circumference that is smaller than the first circumference so as to form a foil wrinkling portion configured to allow twisting of the foil over a limited length of the foil, and wherein the circumference of the outer surface of the mandrel downstream from the second portion does not enlarge.

25. Mandrel according to claim **24**, wherein the sleeving device further comprises:

a frame,

at least one feed unit configured to feed foil to the mandrel,

suspended to the frame, the substantially tubular outer surface of the mandrel extending in an axial direction,

at least a conveyor configured to transport products, such as containers, and to align products with the axial direction of the mandrel,

at least one cutting device configured to cut the foil fed around the mandrel at a first position to form individual sleeves having the predetermined sleeve length, and

at least one sleeve discharge unit configured to discharge sleeves in the axial direction from the mandrel over the product, the sleeve discharge unit engaging the individual sleeve at a second position, wherein the sleeve discharge unit comprises a rotational sleeve discharge unit configured to impart a rotational movement to the sleeve around an axial axis.

* * * * *